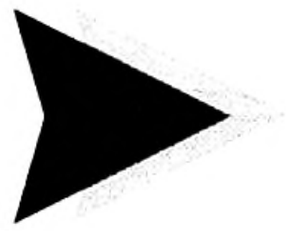

SatisFAXtion® Data Modem/200 User's Guide

PUREDATA®

PureData
Data Modem/200 Guide

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Chapter 1. Introduction

The modem built into the SatisFAXtion fax modem is a 2400 bit-per-second modem that supports the Hayes AT command set, MNP (Microcom Networking Protocol), and CCITT V.42/V.42*bis* standard to eliminate transmission errors and increase transmission speed.

To use the modem, you need modem communications software. Any communications software (such as Crosstalk, Smartcom, and Procomm) written to support the Hayes AT command set will work.

If you have one of these communications programs, you can use your modem without knowing anything about the AT commands. The communications program uses the AT commands, but it hides the details from you. (Depending on the communications program you're using, you're usually presented with a simple menu or function key interface for choosing modem options.)

Most communications programs also provide an AT command mode (also called terminal mode), where you enter AT commands directly. You may need to use these commands when you need more direct control of your modem than your communications program can provide.

WHAT PARTS OF THIS MANUAL SHOULD YOU READ?

If you want to use the SatisFAXtion fax modem only for faxing, skip the rest of this manual.

If you want to use the SatisFAXtion modem, and your communications program provides all the services you need, read just this chapter. It explains how to install, set up, test, and use the modem.

If you want to use the SatisFAXtion modem, and you need to use the AT commands directly, read this chapter and any parts of Chapters 2-9 that apply to you.

INSTALLING THE MODEM

Before you can use your modem and the AT commands described in this manual, you must install the SatisFAXtion hardware and software as described in the SatisFAXtion installation guide.

During the software installation, the SETUP program will automatically add the files SATISFAX.SYS, DOWNLOAD.IPF, and LOADER.IFP to your fax directory and a line for SATISFAX.SYS to your CONFIG.SYS file. (SATISFAX.SYS works only with DOS, not with OS/2 or Xenix.) These files and the SATISFAX.SYS command must be present for the modem to work. If you don't know whether SATISFAX.SYS is installed, look in your CONFIG.SYS file for a line similar to this:

```
DEVICE=C:\FAX\SATISFAX.SYS
```

SETUP will try to configure the modem for a COM port that doesn't conflict with other COM ports in your computer. You can also pick the COM port yourself:

- For classic bus computers, choose *Advanced setup/Set up hardware/Modem I/O, Interrupt* in SETUP.

- For Micro Channel computers, use the reference diskette to change the *Modem Serial Port* setting.

If you have problems configuring your modem, see Appendix A, "COM port information."

TESTING THE MODEM

TESTCOM (a program supplied with the SatisFAXtion software) lets you check whether the modem works correctly. It also verifies that the phone lines are connected correctly.

Follow these steps to start TESTCOM:

▼ **CAUTION** *TESTCOM runs only under DOS. Don't use it with OS/2.*

1 **Be sure you have the following information before you start TESTCOM:**

- The COM port the modem is using.
- The type of phone you have, either pulse dial or tone dial. A tone-dial phone communicates using a series of differently pitched tones. For example, a "1" and a "9" sound different. A pulse-dial phone uses numbered pulses to communicate. For example, a "1" is one pulse, and a "9" is nine pulses.

2 **Go to the FAX directory** (the default directory is FAX on drive C).

3 **To run TESTCOM, type**

```
TESTCOM
```

and press Enter↵. The program is self-explanatory -- just select the options and tests you want.

▼ **NOTE** *TESTCOM is shipped in a compressed format. The first time you run it, you'll see instructions for uncompressing it. Just follow those instructions and then invoke TESTCOM again to run it.*

QUICK AND EASY MODEM SETUP

To set up your modem, follow these steps using your communications software:

1 **Set the modem's speed** (often called baud rate) to at least 9600 bps.

2 **Set "Auto Baud Detect" (or "Auto Baud Adjust" or a similar term) to OFF (or NO).**

3 **Set hardware "Flow Control" (CTS/RTS lines) to ON (or YES).**

4 **Be sure the modem's COM port (COM1, COM2, SERIAL_1, etc.) is set up for the same COM port you specified when you ran SETUP (classic bus computers) or when you updated the reference diskette (Micro Channel computers).** Appendix A, "COM port information," has more information on assigning COM ports.

5 **The modem is already set up for optimum performance,** including MNP class 5 operation. If you send a file that's already compressed, however, the data compression provided by MNP class 5 will actually slow transmission. In that case, for best performance use MNP class 4 (which doesn't include data compression).

To turn off MNP-5 data compression, use your communications software to get into command mode. Then type this command:

```
AT%C0
```

where:

AT	is the attention code.
%C0	turns off data compression (MNP class 5).

▼ **NOTE** *The AT%C0 command remains in effect only until you quit the communications software. To make the change permanent, type this command after you type AT%C0:* `AT&W`.

USING THE MODEM

This section lists considerations for using just the modem and for using the modem while faxing. For a complete description of how the data modem function and fax function interact, see the SatisFAXtion installation guide.

Using the modem only

If you want to use the modem capability of the SatisFAXtion fax modem **but not** the fax capability, you can remove some of the SatisFAXtion software from memory.

When you ran SETUP, it installed the CASMGR and FAXPOP programs. CASMGR requires approximately 5 Kbytes of conventional memory if it uses expanded memory and 62 Kbytes if it doesn't. FAXPOP requires approximately 8 Kbytes of conventional memory.

See the SatisFAXtion user's guide for instructions on removing CASMGR and FAXPOP from memory. If you don't know whether CASMGR and FAXPOP are installed, look in your AUTOEXEC.BAT file for lines similar to these:

```
C:\FAX\CASMGR.EXE   C:\FAX\CASMGR.CFG
C:\FAX\FAXPOP.EXE
```

Using the modem while faxing

Both the modem and fax portions of the SatisFAXtion fax modem use the same phone line, so only one type of activity can occur at a time. However, because faxing happens in the background, you can invoke your communications program while faxing. And if you've scheduled multiple faxes to be sent, you don't have to wait until they're all sent before using the modem.

If you invoke your communication program when fax events are pending, here's what happens:

1. If a fax is currently being sent or received, that event will continue. If you (or your communications program) enter an AT command, the command will be stored in a buffer, but no action will be taken and no response will be displayed on the screen.

2. Once the fax activity ends (or if the fax modem is between sends or retries), the modem interrupts any pending fax activity. The modem accepts your AT command and gives you 25 seconds to enter another (there's a 25-second window after every AT command). If you dial to make a connection, the modem takes over until that connection ends.

3. When you finish using the modem (after a 25-second wait), fax activity resumes where it left off when you interrupted it.

File transfer protocol considerations

A file transfer protocol is a set of rules that governs how data is transmitted. To communicate successfully, two modems must use the same protocol. Single-block ACK or NAK protocols such as XMODEM, YMODEM, or KERMIT slow down file transfers when using error-correcting modems.

For the best performance when transferring files, select a more efficient protocol such as YMODEM/G, ZMODEM, Super KERMIT, or CompuServe B Plus.

USING THE AT COMMANDS

You must run a communications program or a terminal emulation program to use the AT commands. **If you don't have a communications or terminal emulation program running, you can't send instructions to or receive information from the modem.** See the SatisFAXtion user's guide for your communications program to learn how to set up the program for command or terminal mode, so you can enter AT commands directly.

For details about using the AT commands, see chapters in this manual:

2 *Command summary*
Lists and describes all the modem commands in a table. Turn to this chapter for a quick reference.

3 *Entering commands and receiving result codes*
Describes the syntax for entering commands and explains the result codes the modem returns. Read this chapter to learn the basics of entering commands.

4 *Making a call*
Describes the commands used to dial a phone number and connect the modem to a remote modem.

5 *Answering a call*
Describes the commands used to answer the phone and connect the modem to a computer that calls you.

6 *Communication options*
Describes the commands that affect the way the modem communicates with you, with your computer, and with the remote modem.

7 *Error control and data compression*
Describes the commands used to specify options related to Link Access Procedure for Modems (LAPM) and Microcom Networking Protocol (MNP) error control and data compression.

8 *Configuration commands and registers*
Describes the S registers that store the modem's configuration information and the commands that store and retrieve information in these registers.

9 *Diagnostic commands*
Describes the commands available for diagnosing communications problems. Read this chapter if you have trouble connecting your modem to remote modems.

Chapter 2. Command summary

Table 2-1 summarizes all the modem commands described in this manual. It lists the commands in alphabetical order and notes the page number where you can find more detailed information. The factory settings are listed in **bold**.

Table 2-1 *Command summary*

Command	Page	Description
A	5-1	Manual answer.
A/	3-4	Repeat the last command line.
AT	3-2	Attention code. Must precede all commands except A/.
B*n*	6-1	Selecting the 300 bps/1200 bps protocol: B, B0 CCITT V.21/V.22 protocol **B1 Bell 103/Bell 212A protocol**
D *string*	4-1 4-4 4-4 4-5 **4-5** 4-6 4-6 4-6 4-7 4-7	Dial phone number *string*, with these modifiers: P Pulse R Reverse S Dial stored phone number **T Tone** W Wait for a subsequent dial tone @ Wait for quiet , Pause ; Resume command mode after dialing ! Hook flash

Table 2-1 *Command summary (continued)*

Command	Page	Description
E*n*	6-2	Local echo mode: E, E0 No echo **E1 Echo**
H*n*	4-8	Switch hook control: H, H0 On hook (hangs up telephone) H1 Off hook (picks up telephone)
I*n*	9-11	Return product code and status: I, I0 Return product ID I1 Compute ROM checksum and return value I2 Compute ROM checksum and return OK or ERROR I3 Return download version I4 Report modem capabilities
L*n*	6-2	Speaker volume control: L, L0, L1 Low volume **L2 Medium volume** L3 High volume
M*n*	6-3	Speaker on or off: M, M0 Speaker always off **M1 Speaker on until carrier detected** M2 Speaker always on M3 Speaker off when carrier detected and during dialing
O*n*	3-5	Return to on-line mode: O, O0 Return to on-line mode O1 Return to on-line mode and initiate retrain sequence
Q*n*	3-10	Enable or disable result codes: **Q, Q0 Display result codes** Q1 Don't display result codes

Table 2-1 *Command summary (continued)*

Command	Page	Description
S*n*	8-8	Read and write S-registers: S*n* Select S-register *n* as current register S*n*? Read S-register *n* S*n*=*v* Write value *v* in S-register *n*
V*n*	3-10	Verbal or numeric result codes: V, V0 Numeric result codes **V1 Verbal result codes**
X*n*	3-11	Result code and dialing options: X, X0 When modem dials number, it dials without waiting for a dial tone. CONNECT result code (numeric code 1) returned on connection. Doesn't recognize dial tone or busy signal. Only basic result codes can occur. X1 Like X0 except CONNECT result codes 0-5 and 10 can occur. X2 Waits for dial tone before dialing, but doesn't recognize busy signal. CONNECT result codes 0-6 and 10 can occur. X3 Modem doesn't wait for dial tone before dialing but recognizes busy signal. CONNECT result codes 0-5, 7, and 10 can occur. **X4 Waits for dial tone before dialing and recognizes busy signal. All CONNECT result codes can occur.**
Y*n*	6-3	Long space disconnect: **Y, Y0 Long space disconnect disabled** Y1 Long space disconnect enabled
Z*n*	8-7	Fetch configuration profile *n* from nonvolatile RAM (*n*=0,1)
&C*n*	6-4	Data carrier detect (DCD) options: &C, &C0 DCD always on **&C1 DCD on indicates that a suitable data carrier from the remote modem is present; off indicates no carrier is present**

Table 2-1 *Command summary (continued)*

Command	Page	Description
&D*n*	6-5	Data terminal ready (DTR) options: &D,&D0 Modem ignores DTR &D1 Modem switches from on-line to command mode when on-to-off DTR transition occurs **&D2 Modem switches from on-line to command mode, disconnects (hangs up), and disables auto-answer when on-to-off DTR transition occurs** &D3 Modem reinitializes when on-to-off DTR transition occurs
&F	8-4	Fetch factory configuration profile from ROM
&G*n*	6-6	Guard tones: **&G, &G0 No guard tone** &G1 550-Hz guard tone &G2 1800-Hz guard tone
&J*n*	6-6	Phone jack selection: **&J, &J0 RJ11 phone jack** (no A-A1 connection) &J1 RJ12, 13 jack (connects A & A1 leads when modem goes off hook)
&L*n*	6-7	Leased or dialup line selection: **&L, &L0 Dialup line** &L1 Leased line
&P*n*	6-8	Make-to-break pulse dial ratio: **&P, &P0 39% make to 61% break (US and Canada)** &P1 33% make to 67% break (UK and Hong Kong)
&S*n*	6-9	Data set ready (DSR) options: **&S, &S0 DSR always on** &S1 DSR off in command mode and test mode; on during communication

Table 2-1 *Command summary (continued)*

Command	Page	Description
&T*n*	9-1 9-2 9-2 9-4 9-5 9-5 9-5 9-8 9-10	Diagnostic test commands: &T, &T0 Terminate test in progress &T1 Local analog loopback &T3 Local digital loopback connection **&T4 Grant remote digital loopback from remote** &T5 Deny remote digital loopback from remote &T6 Remote digital loopback &T7 Remote digital loopback with self-test &T8 Local analog loopback with self-test
&V	8-5	View active and stored configuration profiles, user profiles (stored with &W), and telephone number (stored with &Z).
&W*n*	8-6	Write active configuration profile *n* to nonvolatile RAM (*n*=0,1).
&Y*n*	8-7	Designate stored profile to use when modem is first turned on: **&Y, &Y0 Use profile 0** &Y1 Use profile 1
&Z=*string*	4-9	Store telephone number *string* in NVRAM.
\A*n*	7-2	Maximum MNP block size: \A, \A0 64 bytes \A1 128 bytes \A2 192 bytes **\A3 256 bytes**
\B*n*	7-2	Send break, where *n* is a multiple of 100 milliseconds (ms) and equals 1-9. **Default: *n*=3 (300 ms).**
\C*n*	7-3	Set auto-reliable buffer: **\C, \C0 Disabled** \C1 Buffer up to 200 data characters. If 200 normal characters are received and no reliable character, establish a normal connection. \C2 Disable the auto-reliable buffer. After receiving the escape character defined by %A, establish a normal connection.

Table 2-1 *Command summary (continued)*

Command	Page	Description
\G*n*	7-4	Set modem-to-modem flow control XON/XOFF (software): **\G, \G0 Disable XON/XOFF** \G1 Enable XON/XOFF
\J*n*	7-4	Adjust serial data rate: **\J, \J0 Disable serial data rate adjustment** \J1 Enable serial data rate adjustment
\K*n*	7-5	Break type, where *n*=0-5. **Default: *n*=5.**
\L*n*	7-6	MNP link type: **\L, \L0 Stream link** \L1 Block link
\N*n*	7-7	Asynchronous connection type: \N, \N0 Normal mode \N1 Reserved \N2 Forced MNP mode **\N3 Auto-reliable mode** \N4 Forced V.42 mode
\O	7-9	Originate MNP reliable connection.
\Q*n*	7-9	Set serial port flow control: \Q, \Q0 Disable control \Q1 Enable bidirectional XON/XOFF control \Q2 The modem turns CTS off to signal that it isn't ready to receive data **\Q3 Enable bidirectional CTS/RTS control** \Q4 Same as \Q1 except modem generates but doesn't respond to XON/XOFF \Q5 Same as \Q2 except modem keeps CTS low until connection is made \Q6 Same as \Q3 except modem keeps CTS low until connection is made
\T*n*	7-11	Inactivity timer, where *n*=0-90 minutes. **Default: *n*=0.**

Table 2-1 *Command summary (continued)*

Command	Page	Description
\U	7-11	Accept MNP reliable connection (requested by remote modem).
\V*n*	3-14	Display error control and data compression information: \V, \V0 Standard CONNECT result codes \V1 CONNECT result codes show general error control information **\V2 CONNECT result codes show full error control and data compression information**
\X*n*	7-12	XON/XOFF flow control pass through: **\X, \X0 Don't pass XON/XOFF through to remote modem** \X1 Pass XON/XOFF through to remote modem
\Y	7-13	Switch to MNP reliable connection.
\Z	7-13	Switch from MNP to normal connection.
%A*n*	7-13	Set auto-reliable fallback character, where *n*=0-127 (used with \C2). **Default: *n*=13** (same as Enter key).
%C*n*	7-14	Enable or disable MNP data compression: %C0 Disabled **%C1 Enabled**
-J*n*	7-14	Detect error control: -J, -J0 Disable error control detection phase **-J1 Enable error control detection phase**
"H*n*	7-15	Enable or disable V.42*bis* data compression "H0 V.42*bis* data compression disabled "H1 Can send but not receive V.42*bis* data compression "H2 Can receive but not send V.42*bis* data compression **"H3 Enable bidirectional V.42*bis* data compression**
"O*n*	7-16	Set maximum V.42*bis* data block size *n* (where *n*=6-250). **Default: *n*=250.**

Chapter 3. Entering commands and receiving result codes

INTRODUCTION

This chapter introduces you to the modem commands. It describes the operating modes of the modem, the command syntax, and the result codes the modem issues to respond to commands you enter. It also describes the modem commands that affect the result codes.

OPERATING MODES

The modem is always in one of two operating modes:

- command mode (also called terminal mode or local mode)
- on-line mode (also called data mode)

With your SatisFAXtion fax modem installed, whenever you turn on your computer, the modem is powered up in command mode. In this mode, any data you send to the modem is interpreted as one or more modem commands. The modem tries to execute each command you send it, and it displays a result code on your computer screen that indicates the results of the command.

Using modem commands, you can establish a connection with a remote modem. When you establish the connection, the modem switches to on-line mode and relays the data you send it to the remote modem. In on-line mode, the modem interprets all information sent to it as data. The only exception is the escape sequence, a special sequence of characters (generally +++) that returns the modem to command mode without breaking the connection. For a discussion of the escape sequence, see "+++ -- Escape sequence" on page 3-4.

AT -- ATTENTION CODE

Every modem command (except the **A/** command, described on page 3-4) must begin with the characters **AT** or **at**. These characters are called the attention code. The attention code tells the modem that one or more modem commands follow.

The attention code must consist of all uppercase or all lowercase characters. The modem will *not* interpret the characters **At** and **aT** as attention codes.

Every time the modem receives an attention code, it determines the communications rate of the serial port, the parity setting, and the number of stop bits. The modem then automatically adjusts its settings to match and stores those settings in its RAM. It maintains these settings until it receives another **AT** attention code, or until you turn off the computer.

COMMAND LINE SYNTAX

A modem command line has this syntax:

AT ***commands***

AT is the attention code that must begin every line. The *commands* are one or more of the modem commands described in this manual. To end the command line, press Enter↵. The modem doesn't process the modem commands until you press Enter↵.

▼ NOTE *You can configure your modem to recognize a different character (other than Enter↵) to end the command line. See Chapter 8 for more information about register S3.*

You don't need to separate the attention code from the commands or the commands from each other. For example, the following command line contains one command to set the speaker volume to high (L3) and one command to dial a phone number (D15035559999):

```
ATL3D15035559999
```

You can include as many spaces as you like in the command line to improve readability. The following command line performs the same operations as the previous one, but it's easier to read:

```
AT  L3   D 1 503 555 9999
```

If you make a mistake when you type a command line, you can backspace over it and retype the line. This applies to all characters except the **AT** attention code. You can't backspace over the attention code.

▼ **NOTE** *You can configure your modem to recognize a different character (other than the backspace key on your keyboard) as the backspace character. See Chapter 8 for more information about register S5.*

COMMAND BUFFER

As you type a command line, the modem puts the commands in a command buffer. This buffer has room for 40 characters. Only the commands themselves are put in the buffer. The **AT** attention code, spaces, and the Enter↵ character aren't put in the buffer.

▼ **CAUTION** *Because the command buffer stores AT commands without any spaces you may have included for readability, use caution when backspacing to make a correction. Backspacing to erase a space might erase a non-space character.*

If you type more than 40 command characters on a command line, the modem ignores the commands and returns the **ERROR** result code on your screen.

A/ -- REPEAT THE LAST COMMAND LINE

The modem stores the last command line in the command buffer until you enter a new command line and press Enter↵. You can repeat the last command without retyping it by using this command:

A/

▼ **NOTE** *This command does not begin with the* **AT** *attention code. It is the only modem command that doesn't require the attention code.*

SWITCHING BETWEEN COMMAND AND ON-LINE MODES

As described earlier in this chapter, the modem is always in one of two operating modes: command or on-line. You can switch between these two modes using the escape sequence +++ (to switch from on-line to command mode) or the **O** command (to switch from command to on-line mode). Both the escape sequence and the **O** command assume you've already established a connection with a remote modem, either by dialing another modem (as described in Chapter 4) or by answering a call from another modem (as described in Chapter 5).

+++ -- Escape sequence

After you've established a connection with a remote modem, you can return to command mode without breaking that connection by typing the escape sequence.

In its factory setting, the escape sequence consists of three plus characters (+++). When you enter the escape sequence, you don't need to begin with the **AT** attention code or type Enter↵ at the end.

▼ **NOTE** *You can change the character used in the escape sequence by changing the value in the S2 register (as described in Chapter 8).*

To prevent the modem from interpreting the data you send as an escape sequence (if that data contains three consecutive plus signs, for example), the modem requires a guard time for the escape sequence. The factory setting for the guard time is one second. So, to be interpreted as a legitimate escape sequence, there must be at least one second before and after the escape sequence in which the modem doesn't receive any characters. Also, you must type the characters of the escape sequence within one second of each other. You can change the guard time setting by changing the value in the S12 register (as described in Chapter 8).

This guard time minimizes the chance that the modem will interpret characters in your data stream as escape sequences. For example, if you transmit a file, it's unlikely that three consecutive plus signs in the file would be preceded and followed by a one-second interval in which no characters are transmitted.

To make the modem interpret the characters you type as the escape sequence, follow these steps:

1. Don't send any characters to the modem for the amount of time set up as the guard time.

2. Type the escape sequence (+++), making sure to type consecutive characters within the guard time. Don't press Enter↵ afterwards.

3. Before transmitting more characters, wait for the amount of time specified as the guard time. When that time expires, the modem should respond with the message **OK** on your screen. The message indicates that the modem is in command mode.

O -- Return to on-line mode

If you've established a connection and the modem is in command mode, the **O** command returns the modem to on-line mode. There are two ways for the modem to be in command mode with an established connection:

- after an escape sequence

- after an on-to-off transition of the DTR signal if you had previously entered the **&D1** command. (See Chapter 6 for a description of the **&D1** command.)

Here's the format of the **O** command:

AT O*n*

The *n* parameter determines the options for returning to on-line mode:

ATO or **ATO0** — Returns the modem to on-line mode.

ATO1 — Returns the modem to on-line mode and initiates a retrain sequence. A retrain sequence causes the connected modems to test the phone line characteristics and optimize their operation to get the best data transmission. Training normally occurs when the modem initially establishes the connection. If the line characteristics change during a session (possibly causing the data to become garbled), you can improve the connection without redialing by issuing the escape sequence to return to command mode and then issuing the **ATO1** command to retrain the modems. The **ATO1** option works only when the modem is operating at 2400 bits per second.

RESULT CODES

When you enter most modem commands, the modem displays a message on your screen indicating the results of the command. These messages are called result codes.

Result codes are ASCII characters preceded and followed by a carriage return and line feed. Result codes are returned in either verbal (English words that describe the conditions) or numeric format. The **V** command (described on page 3-10) switches between verbal and numeric result codes. You can also use the **Q**, **X**, and **\V** commands to determine which result codes the modem returns and how it presents them.

Table 3-1 lists all the result codes the modem can return, their numeric equivalents, and their descriptions. Table 3-2 lists the result codes in numeric order. The rest of this chapter describes the commands that affect result codes. (See Chapter 7 for a description of the MNP acronyms used in Table 3-1.)

Table 3-1 *Result codes*

Verbal code	Numeric code	Description
BUSY	7	The modem detected a busy signal.
CONNECT	1	With **X0** option selected (described on page 3-11), the modem established a connection. With **X1** through **X4** selected, the modem established a connection at 300 bits per second (bps).
CONNECT 300/REL	22	The modem established a reliable (MNP) connection at 300 bps. (To receive this error code, the \V1 command must have been entered.)
CONNECT 300/REL-MNP	32	The modem established a connection at 300 bps using MNP error control.
CONNECT 300/REL-LAPM	52	The modem established a connection at 300 bps using LAPM error control.
CONNECT 300/REL-LAPM-COMP	62	The modem established a connection at 300 bps using LAPM error control and data compression.
CONNECT 1200	5	The modem established a connection at 1200 bps.
CONNECT 1200/REL	24	The modem established a connection at 1200 bps using error control.
CONNECT 1200/REL-LAPM	54	The modem established a connection at 1200 bps using LAPM error control.
CONNECT 1200/REL-LAPM-COMP	64	The modem established a connection at 1200 bps using LAPM error control and data compression.
CONNECT 1200/REL-MNP	34	The modem established a connection at 1200 bps using MNP error control.
CONNECT 1200/REL-MNP-COMP	44	The modem established a connection at 1200 bps using MNP error control and data compression.
CONNECT 2400	10	The modem established a connection at 2400 bps.
CONNECT 2400/REL	25	The modem established a connection at 2400 bps using error control.

Table 3-1 *Result codes (continued)*

Verbal code	Numeric code	Description
CONNECT 2400/REL-LAPM	55	The modem established a connection at 2400 bps using LAPM error control.
CONNECT 2400/REL-LAPM-COMP	65	The modem established a connection at 2400 bps using LAPM error control and data compression.
CONNECT 2400/REL-MNP	35	The modem established a connection at 2400 bps using MNP error control.
CONNECT 2400/REL-MNP-COMP	45	The modem established a connection at 2400 bps using MNP error control and data compression.
ERROR	4	There was an error in the command line, the command line was too long, or the checksum returned by the **I** command (see Chapter 9) was incorrect.
NO ANSWER	8	You entered the @ (wait for quiet) dial modifier (see Chapter 4), and the modem didn't detect five seconds of silence within the timeout period specified in the S7 register (the factory setting is 60 seconds).
NO CARRIER	3	The modem lost the carrier or never received it within the timeout period specified in the S7 register (the factory setting is 60 seconds). Chapter 8 describes the S7 register.
NO DIALTONE	6	The modem didn't receive a dial tone within the timeout period. If you entered the **W** dial modifier (see Chapter 4), the subsequent dial tone must be detected within the time specified in the S7 register (the factory setting is 60 seconds). If you entered the **X2** or **X4** commands (described on page 3-11), the dial tone must occur within five seconds after the modem picks up the phone.
OK	0	Command accepted; no errors occurred.
RING	2	The local phone line is ringing, indicating an incoming call.

Table 3-2 *Result codes sorted numerically*

Numeric code	Verbal code
0	OK
1	CONNECT
2	RING
3	NO CARRIER
4	ERROR
5	CONNECT 1200
6	NO DIALTONE
7	BUSY
8	NO ANSWER
10	CONNECT 2400
22	CONNECT 300/REL
24	CONNECT 1200/REL
25	CONNECT 2400/REL
32	CONNECT 300/REL-MNP
34	CONNECT 1200/REL-MNP
35	CONNECT 2400/REL-MNP
44	CONNECT 1200/REL-MNP-COMP
45	CONNECT 2400/REL-MNP-COMP
52	CONNECT 300/REL-LAPM
54	CONNECT 1200/REL-LAPM
55	CONNECT 2400/REL-LAPM
62	CONNECT 300/REL-LAPM-COMP
64	CONNECT 1200/REL-LAPM-COMP
65	CONNECT 2400/REL-LAPM-COMP

Q -- Enable or disable result codes

The **Q** (quiet) command enables or disables the modem's ability to display the result codes (listed in Table 3-1) on your computer screen. Here's the format of the Q command:

AT Q*n*

The *n* parameter indicates whether to display result codes:

ATQ or **ATQ0**	Causes the computer to display result codes in response to modem commands. This is the factory setting.
ATQ1	Prevents the modem from sending result codes to your computer.

The **ATQ1** command disables only the result codes listed in Table 3-1 (both verbal and numeric codes). Even if you turn off the result codes, the modem will still return S-register values, identification codes, checksum results, and results of diagnostics with self-tests.

V -- Verbal or numeric result codes

The **V** command determines whether the modem will return the verbal result codes listed in the left column of Table 3-1, or whether it will return the numeric equivalents listed in the center column. Numeric result codes are often useful when programs rather than people are issuing modem commands.

Here's the format of the **V** command:

AT V*n*

The *n* parameter specifies whether the modem returns verbal or numeric result codes:

ATV or **ATV0**	The modem returns numeric result codes.
ATV1	The modem returns verbal result codes. This is the factory setting.

X -- Result code and dialing options

The **X** command determines which result codes are enabled. It also governs how the modem deals with dial tones and busy signals when dialing the phone. (See Chapter 4 for more information about dialing the phone.)

Result codes 22 through 65 deal with error control and are controlled by the **\V** command (described on page 3-14).

Result codes 0-4 can't be disabled. These codes are:

0 OK
1 CONNECT
2 RING
3 NO CARRIER
4 ERROR

Result codes 5-10 can be disabled. These are:

5 CONNECT 1200
6 NO DIALTONE
7 BUSY
8 NO ANSWER
10 CONNECT 2400

Here's the format of the **X** command:

AT X*n*

The *n* parameter specifies the extended result code and dialing options:

ATX or **ATX0** The modem returns only result codes 0-4. When dialing, the modem picks up the phone, waits for the amount of time specified in the S6 register (the factory setting is two seconds), and dials the number regardless of whether a dial tone is present. When the modem establishes a connection, it displays a CONNECT result code. If it can't establish a connection in the time specified in the S7 register (the factory setting is 60 seconds), it displays the NO CARRIER result code.

With this option, the modem doesn't recognize dial tones or busy signals.

ATX1 The modem returns result codes 0 through 5-10. The modem's method of dialing is the same as for the **X0** option.

With this option, the modem doesn't recognize dial tones or busy signals.

ATX2 The modem returns only result codes 0-6 and 10. When dialing, the modem waits for a dial tone before dialing. If a dial tone isn't received in five seconds, the modem displays a NO DIALTONE result code.

With this option, the modem doesn't recognize busy signals.

ATX3 The modem returns only result codes 0-5, 7, and 10. The modem's method of dialing is the same as for the **X0** option, except that it recognizes a busy signal and displays the BUSY result code if it detects one.

After dialing, the modem expects a ringback signal within the time specified in the S7 register (the factory setting is 60 seconds). After receiving the ringback, the modem waits up to one S7 time period for a carrier. If either a ringback signal or a carrier does not occur, the modem displays the NO CARRIER result code.

With this option, the modem doesn't recognize dial tones.

ATX4 The modem returns all result codes. When dialing, the modem waits for a dial tone before dialing. If a dial tone isn't received in five seconds, the modem displays a NO DIALTONE result code. The modem displays a BUSY result code if it detects a busy signal. The modem expects ringback and carrier signals as described in the **X3** option.

With this option, the modem recognizes both dial tones and busy signals. This option is the factory setting.

Table 3-3 summarizes the result codes returned for each setting of *n*.

Table 3-3 *How the X command affects result codes and dialing*

Result codes		Setting for X				
Verbal	**Numeric**	**X0**	**X1**	**X2**	**X3**	**X4**
BUSY	7				•	•
CONNECT	1	•	•	•	•	•
CONNECT 1200	5		•	•	•	•
CONNECT 2400	10		•	•	•	•
ERROR	4	•	•	•	•	•
NO ANSWER	8					•
NO CARRIER	3	•	•	•	•	•
NO DIALTONE	6			•		•
OK	0	•	•	•	•	•
RING	2	•	•	•	•	•
Dialing functions						
Recognizes dial tone				•		•
Recognizes busy signal					•	•

\V -- Display error control and data compression information

The **\V** command works in conjunction with the **V** command (described on page 3-10) to display CONNECT result codes with error control and data compression information. Specifically, the **V** command determines whether result codes are numeric or verbal, and the **\V** command determines whether reliable-connection (MNP or LAPM) information is included. (See Chapter 7 for a description of the MNP and LAPM acronyms.)

Here's the format of the **\V** command:

AT\V*n*

The *n* parameter specifies whether the modem returns result codes:

AT\V0 Disables return of error control information with CONNECT result codes. The modem returns only the result codes controlled by the **X** command, which controls result codes 0 through 10. (The **X** command is described on page 3-11.)

AT\V1 Returns minimal information with CONNECT result codes. The result code tells whether the connection is reliable (uses error control), but it doesn't tell the type of error control or whether data compression is also used. This command enables result codes 22 through 25.

Example. A reliable connection at 2400 bps returns the following result code, regardless of the type of error control or data compression:

```
CONNECT 2400/REL
```

AT\V2 Returns full error control and data compression information with CONNECT result codes. It tells the type of error control and whether data compression is used. This command enables result codes 32 through 65. This is the factory setting.

Example. A reliable connection at 2400 bps using LAPM error control and V.42*bis* data compression returns this result code:

```
CONNECT 2400/REL-LAPM-COMP
```

Example. A reliable connection at 2400 bps using MNP error control without data compression returns this result code:

```
CONNECT 2400/REL-MNP
```

\V and numeric result codes

If you set the **V** command to return numeric result codes (two-digit numbers), the transmission speed determines the result code.

- If you use the **\V1** command, the numeric CONNECT result code reveals transmission speed, but it does not reveal the type of error control or data compression. It enables CONNECT result codes 22 through 25:

```
22    CONNECT 300/REL
24    CONNECT 1200/REL
25    CONNECT 2400/REL
```

- If you use the **\V2** command, the numeric CONNECT result code for all reliable connections reveals the type of error control and whether data compression is used. The resulting numeric codes are modifications of codes 22 through 25. The second digit doesn't change from those result codes and thus shows the speed of the connection. The first digit reveals the type of error control or data compression:

First digit	Type of connection
3	MNP, no data compression
4	MNP, MNP class 5 data compression
5	LAPM, no data compression
6	LAPM, V.42*bis* data compression

The CONNECT result codes for connections without error control aren't controlled by the **\V** command. See the **X** command described on page 3-11 for more information.

Example. A reliable connection at 2400 bps using LAPM error control and V.42*bis* data compression returns this numeric result code:

```
65
```

Chapter 4. Making a call

INTRODUCTION

This chapter describes the modem commands you can use to make a call. In the descriptions of the modem commands, the factory settings are shaded.

D -- DIAL

The **D** command causes the modem to dial a phone number. Here's the format of the **D** command:

ATD ***string***

The *string* parameter is a series of characters that can include a phone number and one or more dial modifiers that give the modem additional instructions on how to place the call. The length of the string is limited to the amount of space in the command buffer (40 characters plus the AT command prefix and the Enter↵ key that ends the command).

The characters you can include in the phone number depend on whether you use pulse or tone dialing.

- Pulse dialing, normally used in rotary phones, uses a series of pulses to indicate a phone number (one pulse for a one, two pulses for a two, and so forth). With pulse dialing, the phone number can contain the numbers 0 through 9. (The modem ignores the characters A, B, C, D, #, and * if you choose pulse dialing.)

- Tone dialing, normally used in push-button phones, uses tones of different frequencies to represent different numbers. With tone dialing, the phone number can contain the numbers 0 through 9 plus the characters A, B, C, D, #, and *.

The dial modifiers are:

P Pulse dialing

R Reverse mode

S Dial a stored number

T Tone dialing (factory setting)

W Wait for a subsequent dial tone

@ Wait for quiet

, Pause before sending the next character

; Place modem in command mode after dialing

! Hook flash

The modem ignores any characters in the *string* parameter other than the phone number and dial modifiers. This lets you include spaces and punctuation characters (such as hyphens and parentheses) to make phone numbers more readable, without affecting the number you're dialing. However, even though the modem ignores the extra characters, all but space characters take up space in the command buffer.

Example. The following command dials a number without including any dial modifiers or punctuation:

```
ATD15035559999
```

Example. The following command dials the same number, but includes spaces and punctuation to make the command more readable:

```
AT D 1 (503) 555-9999
```

Example. The following command dials the same number, but includes a dial modifier to indicate tone dialing:

```
AT DT 1-503-555-9999
```

You can include multiple modem commands on one command line. However, if you include the **D** command on the same line with other modem commands, the **D** command (plus any phone number and dial modifiers) must be the last command on the line. If you place other commands after the **D** command, the modem treats them as if they were punctuation characters in the **D** command's parameter string and ignores them.

Example. The **H** command (described on page 4-8) causes the modem to hang up the phone. To include both the **H** and **D** commands in a single line, the **H** command must come before the **D** command, as in this command line:

```
AT H D 1-503-555-9999
```

In the following command line, the **H** command is ignored because the modem considers it part of the **D** command's parameter string:

```
AT D 1-503-555-9999 H
```

After you enter the **D** command, the modem goes off-hook (which is the same as picking up the receiver) and waits for a dial tone. (The amount of time it waits depends on the setting of the **X** command and the contents of the S6 register. For details, see the description of the **X** command in Chapter 3 and the description of the S6 register in Chapter 8.)

After that time period expires, the modem dials the phone and waits for a carrier signal from the remote modem. The amount of time the modem waits for a carrier is set at the factory to 60 seconds, but you can change this timeout interval by changing the S7 register (as described in Chapter 8).

If the modem doesn't receive a carrier signal within the timeout interval, it hangs up the phone and sends this result code:

```
NO CARRIER
```

If the modem receives a carrier signal, it returns one of the CONNECT result codes. Which result code it returns depends on the communication rate and the settings of the **X** and **\V** commands (as described in Chapter 3).

The following sections describe the dial modifiers in detail.

P -- Pulse

The **P** command causes the modem to use pulse dialing when it dials the phone. You can switch between pulse and tone dialing by using the **P** and **T** dial modifiers. Once you indicate a method of dialing, that method remains in effect until you specify another method or turn off the power.

You can use the **P** command as a dial modifier for the **D** command, or you can enter it as a command by itself without dialing the phone.

Example. The following command dials a number using pulse dialing. The **P** command is used as a dial modifier.

```
AT DP 1 (503) 555-9999
```

R -- Reverse

When you dial the phone with the **D** command, your modem goes into originate mode. The **R** dial modifier originates a call in reverse. That is, after your modem connects to the remote modem, your modem switches to answer mode. This lets it communicate with originate-only modems.

The **R** dial modifier must be the last character in the line containing the **D** command.

Example. The following command dials a phone number and places the modem in answer mode.

```
AT D 1-503-555-9999 R
```

S -- Dial stored phone number

The **S** dial modifier causes the modem to dial the phone number stored in the modem's nonvolatile RAM (NVRAM). You can store a phone number in NVRAM by using the **&Z** command (described on page 4-9).

Example. The following command dials the number stored in NVRAM:

```
AT DS
```

T -- Tone

The **T** command causes the modem to use touch tone dialing when it dials the phone. Tone dialing is the **default** dialing method when you turn on the modem. Once you specify the **T** command, touch tone dialing remains in effect until you specify pulse dialing (with the **P** command) or turn off the modem.

You can use the **T** command as a dial modifier for the **D** command, or you can enter it as a command by itself without dialing the phone.

Example. The following command dials a number using touch tone dialing. The **T** command is used as a dial modifier.

```
AT DT 1 (503) 555-9999
```

Example. The following command combines pulse and tone dialing in one command, dialing 9 using pulse dialing and the rest of the number using tone dialing:

```
AT DP 9 T 1 503 555 9999
```

W -- Wait for a subsequent dial tone

The **W** dial modifier causes the modem to wait for another dial tone before dialing the numbers that follow the **W**. This dial modifier doesn't affect the time the modem waits for the first dial tone (which you set with the **X** command, as described in Chapter 3). The **W** dial modifier affects a subsequent dial tone only (such as dialing 9 for an outside line and waiting for another tone).

The length of time the modem waits is set at the factory to 60 seconds. You can change this value by modifying the S7 register (as described in Chapter 8).

Example. The following command dials an access code (9) and then waits up to 60 seconds for a dial tone before continuing to dial the remaining numbers:

```
AT DT 9 W 1 (503) 555 9999
```

@ -- Wait for quiet

The @ dial modifier causes the modem to wait a specified period of time for five seconds of silence. Once the modem detects five seconds of silence, it continues dialing the numbers that follow the @. The length of time that the modem waits is set at the factory to 60 seconds. You can change this value by modifying the S7 register (see Chapter 8).

, -- Pause

The , (comma) dial modifier causes the modem to pause while dialing. This is useful when you're calling from PBX systems that require dialing a number, such as 9, to get an outside line. With these systems, you usually can't continue dialing until you receive another dial tone. The comma lets you wait before continuing to dial, giving the phone system enough time to respond with a dial tone.

The length of time the modem waits when it encounters a comma is set at the factory to 2 seconds. You can change this value by modifying the S8 register (as described in Chapter 8). You can also include multiple commas in the **D** command to extend the amount of time the modem waits.

Example. The following command uses tone dialing to dial a number. It pauses for four seconds between the access code (9) and the rest of the number.

```
AT DT 9,,1 (503) 555-9999
```

; -- Resume command mode after dialing

The ; (semicolon) dial modifier returns the modem to command mode after dialing the number. It doesn't connect to the remote modem, but it holds the line for further commands. When the modem finishes dialing the number, it returns this result code:

```
OK
```

When you use the semicolon dial modifier, you must put it at the end of the command line. The semicolon dial modifier is especially useful when you need to dial a sequence of numbers that's too long to fit in one command line; that is, one that causes the **D** command to be longer than 40 characters. By using the semicolon dial modifier, you can break the long number into two commands. The semicolon is also helpful in electronic transactions (such as banking by phone) to transmit codes and amounts without causing the modem to connect to the remote source in data mode.

Example. The following two commands dial a single phone number. The semicolon dial modifier after the first command causes the modem to return to command mode without releasing the line. The second command dials the remaining numbers and connects to the remote modem.

```
AT DT 1 503 555;
OK              (modem response)
AT DT 9999
```

! -- Hook flash

The ! dial modifier causes the modem to go on-hook (hang up) for 1/2 second. This modifier is useful in PBX systems, where you can use a hook flash to access other phone services, such as transferring a call.

H -- SWITCH HOOK CONTROL

You can use the **H** command to control the phone line relay. The most common use for this command is to hang up the phone from command mode. Here's the format of the H command:

ATH*n*

The *n* parameter, which is optional, governs how the phone line relay is controlled:

ATH or **ATH0**	Causes the line relay to go on-hook (hangs up the phone).
ATH1	Causes the line relay to go off-hook (equivalent to picking up the phone).

Example. This command hangs up the phone:

```
ATH
```

&Z -- STORE PHONE NUMBER

The **&Z** command stores one phone number and its dial modifiers in the modem's nonvolatile RAM (NVRAM). NVRAM maintains the stored number even when you turn off your computer. Here's the format of the &Z command:

AT&Z=*string*

The *string* parameter is similar to the **D** command's *string* parameter. It is a series of characters that includes the phone number and any dial modifiers you want to be in effect when dialing the number.

- Pulse dialing -- the phone number can consist of the digits 0 through 9.
- Tone dialing -- the phone number can consist of the digits 0 through 9 plus the characters A, B, C, D, #, and *.
- Dial modifiers -- includes the characters **P**, **T**, **R**, **W**, **,** (comma), **!**, **@**, and **;** (semicolon). (You can't use the **S** dial modifier with this command.) (See the description of the **D** command on page 4-1 for information about the dial modifiers.)

The *string* parameter can consist of up to 35 characters. Characters other than those described in the previous paragraph are ignored and not included in the count. If you enter more than 35 characters, the modem returns ERROR and stores no characters.

To dial a number stored in NVRAM with the **&Z** command, invoke the **DS** command described on page 4-5.

Example. This command stores the number:

```
AT&Z=T9,,1-503-555-9999
```

And this command dials the number just stored:

```
AT DS
```

MANUAL DIALING

Although the modem can dial the phone, occasionally you might want to dial the phone yourself, perhaps talk to someone, and then connect the modem. Follow these steps to manually dial the phone:

1 **Put your communication program in command (or terminal) mode.** (If your modem is connected to a terminal, turn on the terminal.)

2 **Using the phone hand set, lift the receiver, wait for the dial tone, and dial the number you wish to call.** If necessary, you can talk to your party before connecting the modem. When you talk to them, you will want to agree on an amount of time to wait (such as 15 seconds) before they have their modem "answer" your modem. (See Chapter 5 for more information on setting up the answering modem.) If the remote modem "answers" your modem before your modem is on line, the two modems will not communicate.

3 **When you are ready to connect the modem, type**

```
ATH1
```

and press Enter↵. You can then hang up the receiver.

4 **To tell the modem to go on-line, type**

```
ATO
```

and press Enter↵.

5 **The person at the other end should issue the ATA command (described in Chapter 5) at this point.** The two modems should now be able to communicate.

Chapter 5. Answering a call

INTRODUCTION

In addition to dialing other computers and services, your modem can answer the telephone and connect to computers that are calling you. For example, for two personal computers to exchange information via modem, one computer must initiate the phone call, and the other computer must answer. This chapter describes the commands you use to answer a call.

A -- MANUAL ANSWER

The **A** command causes the modem to go off-hook (pick up the phone) immediately, regardless of whether the telephone is ringing, and take control of the telephone line in answer mode. Here's the format of the **A** command:

ATA

When manually answering a call from a remote modem, you normally wait until your telephone rings, causing the modem to display the RING result code on your screen. You can then enter the **A** command to answer the telephone and connect with the remote modem.

Once you enter the **A** command and the modem answers the phone, the modem is placed in on-line mode. In this mode, the modem doesn't accept modem commands from you. You can return the modem to command mode by typing the escape sequence (normally +++). (See Chapter 3 for more information about the escape sequence.)

MODEM AUTO ANSWER

In addition to answering the phone manually, you can set up the modem to answer automatically. You do this by setting the S0 register to a nonzero value. Here's the format of the command to set the S0 register:

AT S0=*n*

The *n* parameter indicates whether the modem answers. If *n* is set to 0, the modem won't answer. If *n* is set to 1-255, the modem will answer on the number of rings specified in SETUP. See "S0 -- Modem auto answer" in Chapter 8 for information on how to set and read the value in the S0 register. See "Answering incoming calls" in the SatisFAXtion installation guide for details about how the fax modem answers the phone.

Even if you set the modem to automatically answer the phone, you can still use the **A** command described in the previous section to override the automatic answer facility and manually answer the phone.

Chapter 6. Communication options

INTRODUCTION

This chapter describes the modem commands that control the way the modem communicates.

B -- SELECTING THE 300 BPS/1200 BPS PROTOCOL

The **B** command selects the protocol for 300 and 1200 bits per second (bps) operation. Here's the format of the **B** command:

AT B*n*

The *n* parameter lets you choose between CCITT (*n*=0) and Bell (*n*=1) protocols, when operating at 300 and 1200 bps modem rates:

Modem rate	Protocol	*n*
300 bps	CCITT V.21	0
1200 bps	CCITT V.22	0
300 bps	Bell 103	1
1200 bps	Bell 212A	1

When you enter the **B** command:

ATB or **ATB0**	Sets the modem to CCITT protocols: V.21 at 300 bps and V.22 at 1200 bps.
ATB1	Sets the modem to Bell protocols: 103 at 300 bps and 212A at 1200 bps. This is the modem's factory setting.

E -- LOCAL ECHO MODE

The **E** command determines whether the modem echoes the commands you enter locally back to your local computer screen when in command mode. Here's the format of the **E** command:

AT E*n*

The *n* parameter determines whether the modem echoes local commands:

ATE or **ATE0**	Sets modem to not echo local commands.
ATE1	Sets modem to echo local commands. This is the modem's factory setting.

L -- SPEAKER VOLUME CONTROL

The **L** command sets the speaker volume. Here's the format of the L command:

AT L*n*

The *n* parameter determines the volume:

ATL, **ATL0** or **ATL1**	Selects low volume.
ATL2	Selects medium volume. This is the factory setting.
ATL3	Selects high volume.

The **L** command selects the speaker volume only. It doesn't turn the speaker on or off. The **M** command (described in the next section) turns the speaker on and off.

M -- SPEAKER ON OR OFF

The **M** command turns the speaker on and off. Here's the format of the M command:

AT M*n*

The *n* parameter indicates when the speaker is on or off:

ATM or **ATM0**	Turns off the speaker at all times.
ATM1	Turns on the speaker until the modem receives a carrier signal from the remote modem. This setting lets you monitor both the dialing and carrier-handshaking progress. This is the factory setting.
ATM2	Turns on the speaker at all times.
ATM3	Turns off the speaker when the modem receives a carrier signal from the remote modem and when the modem dials. This setting lets you monitor the carrier handshaking progress only.

Y -- LONG SPACE DISCONNECT

The **Y** command controls whether the modem disconnects when it receives a break signal for 1.6 seconds or longer from the remote modem. Here's the format of the **Y** command:

AT Y*n*

The *n* parameter determines the setting:

ATY or **ATY0**	Disables the long space disconnect feature. Receiving a break signal won't cause the modem to disconnect. This is the factory setting.

ATY1 Sets the modem to disconnect when it receives a break signal for 1.6 seconds or longer from the remote modem. When the modem receives an **H0** command to disconnect, it sends a four-second break signal before disconnecting. It also sends a break signal if you've invoked the **&D2** command and an on-to-off transition of the DTR signal occurs.

&C -- DATA CARRIER DETECT (DCD) OPTIONS

The **&C** command controls how the modem treats the data carrier detect (DCD) signal. The DCD signal indicates whether the modem is receiving a carrier from a remote modem. The setting of this option depends on the communication software used with the modem. Most personal computer software uses the factory setting. Here's the format of the **&C** command:

AT &C*n*

The *n* parameter determines how DCD is treated:

AT&C or **AT&C0** The modem maintains the DCD signal on, regardless of the state of the remote modem's data carrier.

AT&C1 The DCD signal matches the state of the remote modem's data carrier. That is, when the modem is receiving a suitable data carrier, DCD is on. This is the factory setting.

&D -- DATA TERMINAL READY (DTR) OPTIONS

The **&D** command controls how the modem treats the data terminal ready (DTR) signal. The DTR signal indicates whether a local computer is connected to a local modem. The setting of this option depends on the communications program you're using with the modem. Most communications programs use the factory setting. Applications such as bulletin board software, programs that control multiple phone lines, or multitasking or multiuser applications might require other settings. Here's the format of the **&D** command:

AT &D*n*

The *n* parameter determines how DTR is treated:

AT&D or **AT&D0**	The modem ignores the DTR signal.
AT&D1	The modem switches from data to command mode when an on-to-off transition of DTR occurs.
AT&D2	When an on-to-off transition of DTR occurs, the modem switches from data to command mode, goes on-hook (hangs up), and disables auto answer. You can re-establish auto answer by turning on DTR. This is the factory setting.
AT&D3	An on-to-off transition of DTR reinitializes the modem. The initialization caused by the DTR transition is the same as if you had entered the **Z** command (described in Chapter 8). Part of the initialization causes the configuration settings to be overwritten by the settings stored in nonvolatile RAM (NVRAM).

The **&D1**, **&D2**, and **&D3** commands set up the modem to react to changes in DTR. To have an effect, the new state of DTR must last longer than the time specified in the S25 register. See "S25 -- Time DTR must remain off" in Chapter 8 for more information about the S25 register.

&G -- GUARD TONES

The **&G** command controls the generation of guard tones. These tones are used internationally, except in the United States, to indicate that a line is ready to receive data. Here's the format of the **&G** command:

AT &G*n*

The *n* parameter determines the guard tone:

AT&G or **AT&G0**	No guard tones. This is the factory setting.
AT&G1	The modem generates a 550-Hz guard tone.
AT&G2	The modem generates an 1800-Hz guard tone.

&J -- THE PHONE JACK

The **&J** command tells the modem whether it's plugged into an RJ11 jack or into an RJ12 or RJ13 jack. An RJ11 jack is the type used in most homes. RJ12 and RJ13 jacks are the type used on a PBX system. RJ12 and RJ13 jacks contain two extra leads, that, when connected, indicate that the line is busy. Here's the format of the **&J** command:

AT &Jn

The *n* parameter determines the jack type:

AT&J, or **AT&J0**	This is the setting for use with an RJ11 jack. The modem does not assume that the A and A1 leads are there, and does not try to connect them. This is the factory setting.
AT&J1	This is the setting for use with an RJ12 or RJ13 jack. The modem tries to connect the A and A1 leads when it takes the phone off-hook.

&L -- LEASED OR DIALUP LINE SELECTION

The **&L** command selects the type of line that the modem is connected to: leased or dialup. Here's the format of the &L command:

AT &L*n*

The *n* parameter selects the type of line:

AT&L or **AT&L0**	Selects a dialup line. This line can be full or half duplex. This is the factory setting.
AT&L1	Selects a leased line.

Dialup lines are regular phone lines, with dial tones, carriers, and phone signals.

Leased lines, or dedicated lines, are usually cables that directly connect two computers via modems. Businesses usually use this method of connecting two computers because it ensures line quality.

Because a leased line is simply a pair of wires, there is no dial tone, ring indicators, or other kinds of signals that a dialup line provides. Thus, when you choose the **&L1** option, the modem ignores the time limits it otherwise follows when waiting for dial tones, carriers, and other phone signals. Commands to dial phone numbers also don't apply.

To connect two modems via a leased line, one modem must be in originate mode and the other must be in answer mode. For example, when you're using the **&L1** option, enter this command to place one modem in leased-line originate mode (the **D** command without dial modifiers selects originate mode):

```
AT&L1 D
```

and press Enter↵.

Enter this command to place the other modem in leased-line answer mode:

```
AT&L1 A
```

and press Enter↵.

Once you enter the commands, the two modems begin negotiating for a connection.

▼ **NOTE** *When the modem is set up to use a leased line with the* **&L1** *command, the speaker is always off.*

&P -- MAKE-TO-BREAK PULSE DIAL RATIO

The **&P** command controls the ratio of off-hook time (make) to on-hook time (break) during pulse dialing. You should set this ratio as required by the phone system of the country you're in. Here's the format of the **&P** command:

AT &P*n*

The *n* parameter selects the make-to-break ratio:

AT&P or **AT&P0**	Sets a ratio of 39 percent make to 61 percent break, which is the standard for the United States and Canada. This is the factory setting.
AT&P1	Sets a ratio of 33 percent make to 67 percent break, which is compatible with the United Kingdom and Hong Kong.

&S -- DATA SET READY (DSR) OPTIONS

The **&S** command determines how the modem treats the data set ready (DSR) signal. The DSR signal indicates whether the modem is ready to send and receive characters with the remote modem. The setting of this option depends on the communication software you're using with the modem. Most personal computer software uses the factory setting. Applications that treat the modem strictly as a data modem without intelligent features might use the other setting. Here's the format of the **&S** command:

AT &S*n*

The *n* parameter determines how DSR is treated:

AT&S or **AT&S0**	The modem causes the DSR signal to stay on at all times while the modem is turned on. This is the factory setting.
AT&S1	The modem causes the DSR signal to operate in accordance with CCITT V.22*bis* recommendations. The DSR signal is off in command and diagnostics modes, and is on in on-line mode.

Chapter 7. Error control and data compression commands

INTRODUCTION

Noisy phone lines and other signal distortions can introduce errors in the data you send with your modem. The PureData SatisFAXtion modem supports two error control protocols to compensate for noisy phone lines and other signal distortions. Both of these protocols detect errors and resend blocks of data until all the data has been sent error-free. These protocols are:

- Link Access Procedure for Modems (LAPM) -- recommended in the CCITT V.42 specification as the primary error control protocol.

- Microcom Networking Protocol (MNP) -- recommended in the CCITT V.42 specification as the backup error control protocol.

Each protocol can work with a different data compression protocol to increase the speed of your transmissions:

- LAPM can work with the data compression protocol that conforms to the CCITT V.42*bis* specification for data compression. When your SatisFAXtion modem is communicating with another modem that supports V.42*bis* data compression, they can communicate up to four times faster than if they were transmitting data without using data compression.

- MNP error control classes 1-4 can use the MNP class 5 data compression protocol. When your SatisFAXtion modem is communicating with another modem that supports MNP class 5 data compression, they can communicate up to two times faster than they can without using data compression.

In the descriptions of the modem commands, the factory settings are shaded.

\A -- MAXIMUM MNP BLOCK SIZE

The **\A** command specifies the maximum size for a data block during MNP class 4 and 5 operations. Sending large blocks of data when phone lines are noise-free improves performance by reducing error-control overhead. Sending small blocks of data when phone lines are noisy improves performance by reducing retransmissions.

The **\A** command doesn't affect MNP class 3 or lower operations. Here's the format of the **\A** command:

AT \A*n*

The *n* parameter sets the maximum block size:

AT\A or AT\A0	Sets the maximum block size to 64 bytes.
AT\A1	Sets the maximum block size to 128 bytes.
AT\A2	Sets the maximum block size to 192 bytes.
AT\A3	Sets the maximum block size to 256 bytes. This is the modem's factory setting.

\B -- SEND BREAK

The **\B** command sends a break signal to the remote modem. (See the discussion of the **\K** command on page 7-5 for more information on the effect of the break signal.) Here's the format of the **\B** command:

AT \B*n*

The *n* parameter indicates the length of the break signal, where *n* is a multiple of 100 milliseconds. The longer the break signal, the more likely the remote modem will be to recognize the break because it won't mistake the break signal for a carrier or other signal. Valid values for *n* are 1 through 9.

If you don't include the *n* parameter, the modem will send a break signal for the default amount of milliseconds.

The break signal length for reliable mode is always 300 milliseconds, so you don't have to include *n* with the **\B** command when the modem is in reliable mode. This is the modem's factory setting.

\C -- SET AUTO-RELIABLE BUFFER

The **\C** command controls whether the local modem will buffer data coming from the remote modem while the two modems are negotiating for a reliable (LAPM or MNP) connection. It also determines whether the modem will try to detect the fallback character specified with the **%A** command. (See page 7-13 for a description of the **%A** command.) Here's the format of the **\C** command:

AT \C*n*

The *n* parameter determines whether the data received by the modem is buffered and how the fallback character is handled:

AT\C or **AT\C0**	While negotiating for a reliable connection, no buffering occurs, and fallback-character detection is disabled. This is the modem's factory setting.
AT\C1	The local modem buffers up to 200 characters while negotiating for a reliable connection, and no fallback-character detection occurs. If the buffer fills with data, or if three seconds elapse from the time of connection before a reliable connection is made, the local modem makes a normal connection and passes the buffered data to the local computer.
AT\C2	No buffering of data occurs during negotiation for a reliable connection and fallback-character detection does occur. If the modem detects the fallback character while it's trying to make a reliable connection, it makes a normal connection.

\G -- SET MODEM-TO-MODEM FLOW CONTROL (XON/XOFF)

The **\G** command turns on modem-to-modem XON/XOFF flow control (software flow control) during a normal connection. XON/XOFF flow control helps the modem handle data more efficiently when the modem is receiving data from the remote modem faster than it can process the data. Here's the format of the **\G** command:

AT \G*n*

The *n* parameter turns XON/XOFF flow control on and off:

AT\G or **AT\G0**	Turns off XON/XOFF flow control. This is the modem's factory setting.
AT\G1	Turns on XON/XOFF flow control.

See the discussion of the **\Q** command on page 7-9 for more information on XON/XOFF flow control.

\J -- ADJUST SERIAL DATA RATE

The **\J** command lets the modem adjust the rate at which it exchanges data with the computer through the serial port, regardless of the modem-to-modem connection speed. Here's the format of the **\J** command:

AT \J*n*

The *n* parameter enables or disables the serial data rate adjustment:

AT\J or AT\J0	Disables serial data rate adjustment. This lets you maintain a high data rate between the computer and the modem, even when the modem is communicating with another modem at a lower data rate. This option is especially useful with data compression. This is the modem's factory setting.

ATJ1 Enables data rate adjustment, so the serial data rate is automatically adjusted to match the modem-to-modem data rate. Use this setting if your communication software is set up either to recognize the modem's responses and switch to the correct baud rate or to detect carriage return characters and adapt to their baud rate (auto-baud).

If you use this option, make sure the **\Q** command (described on page 7-9) is set to its factory setting. Otherwise you may lose data.

\K -- BREAK TYPE

The **\K** command tells the modem how to handle a break signal received from either the local computer or the remote modem. Here's the format of the **\K** command:

AT \K*n*

The *n* parameter determines how the modem handles a break signal. Table 7-1 shows the possible values for *n*, depending on the condition of the modem-to-modem connection. The modem's factory setting is **\K5**.

Table 7-1 *The \K command parameters*

	Break received from local computer during reliable or normal connection	Break received from remote modem during normal connection	\B*n* command received from local computer while in command mode during reliable or normal connection
\K0	Enter command mode.	Purge buffers, immediately send break to local computer.	Purge buffers, immediately send break to remote modem.
\K1	Purge buffers, immediately send break to remote modem.	Same as **\K0**.	Same as **\K0**.
\K2	Same as **\K0**.	Immediately send break to local computer.	Immediately send break to remote modem.
\K3	Immediately send break to remote modem.	Same as **\K2**.	Same as **\K2**.
\K4	Same as **\K0**.	Send break to local computer in sequence with data.	Send break to remote modem in sequence with data.
\K5	Send break to remote modem in sequence with data.	Same as **\K4**.	Same as **\K4**.

\L -- MNP LINK TYPE

The **\L** command selects the type of link (stream or block) that the modem uses during a reliable connection. Here's the format of the **\L** command:

AT\L*n*

The *n* parameter selects the link type:

AT\L or AT\L0 Sets the modem for a stream link. With a stream link, the modem's maximum block size is specified by the **\A** command (described on page 7-2). This is the modem's factory setting.

AT\L1 Sets the modem for a block link. With a block link, the modem's block size is a maximum of 260 characters.

\N -- ASYNCHRONOUS CONNECTION TYPE

The **\N** command determines the type of asynchronous connection the modem will try. A modem that's only LAPM can't communicate with a modem using MNP. This command guarantees that your modem will be able to automatically communicate with modems that support LAPM, MNP, or no error control. Here's the format of the **\N** command:

AT \N*n*

The *n* parameter specifies the type of connection.

You can specify any of four types of data connections: LAPM (V.42), MNP, normal, and diagnostics mode.

▼ **NOTE** *The definitions that follow apply only when the* **-J1** *command (described on page 7-14) is in effect, which is the factory setting. When the* **-J0** *command is in effect, connections such as a V.42 connection can't automatically negotiate the type of error control and data compression.*

- **A V.42 data connection** uses LAPM as the primary error control protocol and MNP as a backup protocol. When the modem makes the connection, it first tries LAPM error control. If the remote modem can use LAPM, the modems will communicate using LAPM error control. If the remote modem can't use LAPM, but can use MNP, the modems will communicate using MNP error control. If the remote modem can use neither, the modems will establish a normal connection.

  LAPM error control can use data compression that conforms to the CCITT V.42*bis* specification for data compression. MNP error control can use the MNP class 5 data compression protocol. Connections that don't use error control don't use data compression.

- **An MNP data connection** uses MNP error control. The modem can establish an MNP data connection only with a modem that can also use MNP error control.

  MNP error control can use the MNP class 5 data compression protocol.

- A normal connection doesn't use error control but lets error control pass through. A modem can establish a normal connection and communicate with another modem that has established a normal connection. You can use serial flow control (set with the **\Q** command described on page 7-9) with a normal connection. You can also set the serial data rate (with the **\J** command described on page 7-4) to a different speed than that of the modem-to-modem connection.

  Connections that don't use error control don't use data compression.

Table 7-2 describes the types of connections you can make between an originating and answering modem, depending on how you set the **\N** command. The modem's factory setting is **\N3**. (The **\N1** option isn't shown in this table because it's reserved.)

\N0, **\N2**, **\N3**, and **\N4** modes use the hardware flow control method defined by the **\Q** command described on page 7-9.

Table 7-2 *\N settings and connection types*

\N setting for answering modem	**\N** setting for originating modem			
	AT\N0	**AT\N2**	**AT\N3**	**AT\N4**
AT\N0	Normal	Modems hang up	Normal	Modems hang up
AT\N2	Modems hang up	MNP	MNP	MNP
AT\N3	Normal	MNP	LAPM	LAPM
AT\N4	Modems hang up	MNP	LAPM	LAPM

\O -- ORIGINATE MNP RELIABLE CONNECTION

The **\O** command lets you switch on-line to an MNP reliable connection after you've made a normal connection. You can use this command regardless of whether the local modem originated or answered the call. Here's the format of the **\O** command:

AT \O

Before you use this command, you must establish a normal connection with the remote modem, and the **\U** command must have been sent to the remote modem. You then have 12 seconds to type the escape sequence +++ and enter the **\O** command.

The local modem tries to originate an MNP reliable connection as soon as it receives the **\O** command. If the modem can't make a reliable connection, it tries again. If the second try fails, the modem returns to its normal connection. If the modem has already established an MNP reliable connection, the **\O** command won't change this connection.

\Q -- SET SERIAL PORT FLOW CONTROL

The **\Q** command selects the type of flow control used between the local modem and the local computer to prevent the modem's buffer from overflowing. You can choose from two types of flow control:

- Software flow control (XON/XOFF -- transmit-on/transmit-off), where the modem inserts ASCII characters in the data stream to control data flow.

- Hardware flow control (CTS/RTS -- clear-to-send/request-to-send), where dedicated RS-232 signal lines between the modem and the local computer are used to control data flow.

Both types allow the modem to tell the local computer

- to stop sending data to the modem when the modem's data buffer is full, and

- to start sending data again when the buffer can hold more data.

Here's the format of the **\Q** command:

AT \Q*n*

The *n* parameter specifies the flow control method:

AT\Q, AT\Q0	Turns off all flow control.
AT\Q1	Selects bidirectional XON/XOFF (software) flow control. The modem and local computer send ASCII characters to start and stop data transmission between the two. (See the **\X** command described on page 7-12.)
AT\Q2	Selects unidirectional CTS flow control. The modem tells the local computer that the modem is ready for more data by turning on the CTS signal. The modem turns off the CTS signal to tell the computer not to send data.
AT\Q3	Selects bidirectional RTS/CTS flow control. The modem and local computer use the CTS signal to start and stop data transmission. When the computer sends an RTS signal, the modem knows that the computer wants to transmit data. If the modem is ready to receive the data, it replies with a CTS signal. Likewise, the modem sends the computer a CTS signal when it has data to send to the computer, which sends an RTS signal when it can receive data. This is the factory setting.
AT\Q4	Selects unidirectional XON/XOFF flow control. Same as the **\Q1** option, except the modem doesn't respond to XON/XOFF signals from the computer.
AT\Q5	Selects unidirectional CTS flow control with CTS off before the connection. This option is the same as the **\Q2** option, except the modem keeps the CTS signal off until a connection has been established with a remote modem.

AT\Q6 Selects bidirectional RTS/CTS flow control with CTS off before the connection. This option is the same as the **\Q3** option, except the modem keeps the CTS signal off until it establishes a connection with a remote modem.

RTS/CTS flow control is very fast because RTS and CTS are RS-232 signals.

XON/XOFF (software) flow control is slower than RTS/CTS flow control because the XON and XOFF are ASCII characters that must be transmitted with the rest of the data.

\T -- INACTIVITY TIMER

The **\T** command tells the modem to disconnect if no data activity has occurred for the time specified by *n*. Here's the format of the **\T** command:

AT \T*n*

The *n* parameter specifies the length of time to wait (in minutes) with no data activity detected before disconnecting, where *n* is between 0 and 90 minutes. The default is 0, which disables the inactivity timer.

\U -- ACCEPT MNP RELIABLE CONNECTION

The **\U** command sets up the modem to accept an on-line request from the remote modem to switch to an MNP reliable connection, after you've already established a normal connection. You can use this command regardless of whether the local modem originated or answered the call. Here's the format of the **\U** command:

AT \U

Before you use this command, you must establish a normal connection with the remote modem. You then type the escape sequence +++ (to go to command mode) and enter the **\U** command.

The local modem then waits 12 seconds for a request from the remote modem to establish the MNP reliable connection. If the connection attempt fails, the modem returns to its normal connection. If the modem has already made an MNP reliable connection, the **\U** command won't change this connection.

\X -- XON/XOFF FLOW CONTROL PASS-THROUGH

When the **\Q1** command is in effect, the host computer and local modem use XON and XOFF characters (software flow control) to control the flow of data between the computer and the local modem. The **\X** command controls whether the XON and XOFF characters are sent from the local modem to the remote modem. Here's the format of the **\X** command:

AT \X*n*

The *n* parameter specifies whether to pass the XON and XOFF characters to the remote modem:

AT\X, AT\X0	Recognize but don't pass the XON and XOFF characters to the remote modem. This is the modem's factory setting.
AT\X1	Recognize and pass the XON and XOFF characters to the remote modem.

\Y -- SWITCH TO MNP RELIABLE CONNECTION

The **\Y** command combines the functions of the **\O** and **\U** commands, letting you switch on-line to an MNP reliable connection once you've already made a normal connection. Here's the format of the **\Y** command:

AT \Y

Before sending the **\Y** command, type the escape sequence +++ to enter command mode.

If the modem can't establish an MNP reliable connection, it returns to the normal connection. If the modem has already established an MNP reliable connection, the **\Y** command won't change this connection.

\Z -- SWITCH FROM MNP TO NORMAL CONNECTION

The **\Z** command tells the modem to end the MNP reliable connection and switch to a normal connection. Any data in the buffers will be lost. (Before sending the **\Z** command, type the escape sequence +++ to enter command mode.) Here's the format of the **\Z** command:

AT \Z

If the modem is currently operating with a normal or LAPM connection, entering the **\Z** command won't change that connection.

%A -- SET AUTO-RELIABLE FALLBACK CHARACTER

The **%A** command specifies the character that tells the modem to return (fallback) from reliable mode to normal mode when the **\C2** command is in effect. (The **\C** command is described on page 7-3.) You must enter the **%A** command before the reliable connection is made for the command to be effective. Here's the format of the **%A** command:

AT %A*n*

The *n* parameter determines the fallback character and can be any decimal integer between 0 and 127. The value of *n* represents the ASCII code for the keyboard character that you wish to use as the fallback character. (If you enter the fallback character from the keyboard while the modem is negotiating for a reliable connection, the modem falls back to a normal connection.) The default setting is 13, which is the Enter↵ key.

%C -- ENABLE OR DISABLE MNP DATA COMPRESSION

The **%C** command enables MNP class 5 data compression. Here's the format of the **%C** command:

AT %C*n*

The *n* parameter enables or disables MNP class 5 data compression:

AT%C0	Disables MNP class 5 data compression.
AT%C1	Enables MNP class 5 data compression. This is the modem's factory setting.

Data will be compressed using MNP class 5 only during reliable transmission with another modem that supports the MNP error control and data compression protocols.

-J -- DETECT ERROR CONTROL

The **-J** command specifies whether V.42 automatic error control detection handshaking is used. Here's the format of the **-J** command:

AT -J*n*

The *n* parameter enables or disables V.42 automatic error control detection handshaking:

AT-J or **AT-J0**	Disables the modem's generation of (in originate mode) or detection of (in answer mode) error control detection handshaking.

AT-J1	Enables the modem's generation of (in originate mode) or detection of (in answer mode) error control detection handshaking. This is the factory setting.

Some older modems that don't support error control can't tolerate the time needed to do automatic error control detection handshaking. To improve your ability to connect to one of these older modems or to a V.42 modem, use the **\N3** command and disable automatic error control handshaking with the **-J0** command.

When you use **-J1**, the two modems don't need to have the same setting for **\N** (described on page 7-7) to establish a reliable connection. With settings of **\N3** and **\N4**, at the beginning of a call, the two modems send each other control characters to determine whether to use MNP or LAPM error control and corresponding data compression.

When you use **-J0**, **\N3** and **\N4** will cause the modems to skip the V.42 automatic error control detection handshaking sequence and assume LAPM (no MNP connection is made). To establish an MNP connection with **-J0**, use **\N2**. With **\N3**, the modem will fall back to a normal connection if a LAPM connection can't be made.

"H -- ENABLE OR DISABLE V.42*bis* DATA COMPRESSION

The **"H** command determines whether V.42*bis* data compression is enabled or disabled. Here's the format of the **"H** command:

AT "H*n*

The *n* parameter determines whether V.42*bis* data compression is enabled or disabled:

AT"H, AT"H0	Disables V.42*bis* data compression.
AT"H1	Enables V.42*bis* data compression unidirectionally. The modem can send data compressed using the V.42*bis* data compression protocol, but it can't receive and decode data compressed using this protocol.

AT"H2	Enables V.42*bis* data compression unidirectionally. The modem can receive and decode data compressed using the V.42*bis* data compression protocol, but it can't send data compressed using the V.42*bis* data compression protocol.
AT"H3	Enables V.42*bis* data compression bidirectionally. The modem can send, receive, and decode data compressed using the V.42*bis* data compression protocol. This is the factory setting.

"O -- SET MAXIMUM V.42*bis* DATA BLOCK

The "**O** command determines the largest data block that can be represented by a V.42*bis* code. Here's the format of the "**O** command:

AT "O*n*

The *n* parameter determines the largest data block that can be represented by a V.42*bis* code, where *n* is between 6 and 250 characters. The default value is 250, which lets you compress the most data. You'll need to set *n* to a smaller value only for very specialized applications.

V.42*bis* compresses data by substituting a code sequence for a larger block of data. The smaller code sequence takes less time to transmit and is decoded by the receiving modem, which interprets the sequence as the original block of data. The larger the block of data, the faster your transmission can be.

Chapter 8. Configuration commands and registers

INTRODUCTION

This chapter describes the commands that set and retrieve the modem's configuration settings. These settings are stored in configuration registers called S registers. A subset of the S registers is stored in nonvolatile RAM (random access memory), so you can save the contents of the S registers and have their settings restored the next time you turn on your computer.

The first few sections of this chapter describe the configuration settings that are saved and the factory settings of the S registers. The configuration commands, most of which are used to manipulate S registers, are described next. The rest of the chapter describes the S registers themselves.

ACTIVE CONFIGURATION PROFILE

The operating characteristics of the modem are stored in S registers in the modem's volatile RAM. Whenever you issue a modem command to change one of the operating characteristics (such as setting the volume control or turning the speaker on or off), the modem changes the values in the S registers to reflect your changes. The current settings of the S registers are called the *active configuration profile*.

When you start your computer, the modem establishes the active configuration profile by setting the S registers to initial values. It gets some of these initial values from the modem's ROM (read-only memory), and it gets others from nonvolatile RAM. The difference between ROM and nonvolatile RAM is that the values in ROM are fixed: whenever you turn on the computer, the original values are loaded into the S registers. On the other hand, you can change the values in nonvolatile RAM, and the modem will remember your changes the next time you turn on the computer. See the description of the **&W** command later in this chapter for information about changing the values stored in nonvolatile RAM.

Table 8-1 lists the configuration parameters and their factory settings. It also indicates which parameters are initialized from nonvolatile RAM, allowing you to change or save their initial values.

Table 8-1 *Configuration parameters*

Parameter	*Factory setting*	*Initialized from NVRAM*	*Associated command or S register*
Communication rate	2400 bps	yes	S21 and S23
1200 bps protocol	Bell 212A	yes	B1
Parity	None	yes	S23
Automatic answer	Disabled (ring count=0)	yes	S0=0
Echo	On	yes	E1
Result codes enabled	All	yes	X4
Result codes	Verbal	yes	V1
Wait for dial tone before dialing	Enabled	no	X4
Busy signal detect	Enabled	no	X4
Pulse dial make/break ratio	39/61	yes	&P0
Test timer timeout	0 seconds	yes	S18=0
RTS-to-CTS delay	10 milliseconds	yes	S26=1
DTR option	DTR disconnects modem	yes	&D2
DSR option	DSR always on	yes	&S0
Long space disconnect	Disabled	yes	Y0
Speaker	Enabled and on	yes	M1
Speaker volume	Medium	yes	L2
Guard tone	Disabled	yes	&G0
Minimum DTR pulse width	0.05 seconds	yes	S25=5
Escape sequence character	43	no	S2=43
Carriage return character	13	no	S3=13
Line feed character	10	no	S4=10
Backspace character	08	no	S5=8
Wait before blind dialing	2 seconds	no	S6=2
Wait for carrier after dialing	60 seconds	yes	S7=60
Dial pause (comma)	2 seconds	no	S8=2
Carrier detect response time	0.6 seconds	no	S9=6
Lost carrier to hangup delay	1.4 seconds	no	S10=14
Escape sequence guard time	1.0 seconds	no	S12=50

Table 8-1 *Configuration parameters (continued)*

Parameter	*Factory setting*	*Initialized from NVRAM*	*Associated command or S register*
Data carrier detect (DCD)	DCD on only when modem detects carrier	yes	&C1
Leased/dialup line selection	Dialup	yes	&L0
Status of remote digital loopback test	Loopback on	yes	&T4, &T5
Maximum MNP block size	256 bytes	yes	\A3
Auto-reliable buffer	Disabled	yes	\C0
Modem-to-modem flow control	Disabled	yes	\G0
Bps rate adjust	Disabled	yes	\J0
Break control	n=5	yes	\K5
Operating mode	Auto-reliable mode	yes	\N3
Serial port flow control	CTS/RTS control enabled	yes	\Q3
Inactivity timer	n=0	yes	\T0
Show error control/data compression information	Show full information	yes	\V2
XON/XOFF pass through	Don't pass through	yes	\X0
Auto-reliable fallback character	n=13 (carriage return)	yes	%A13
Data compression	Enabled	yes	%C1
Auto retrain	Enabled	yes	%E1
Error control detection phase selection	Enabled	yes	-J1
V.42*bis* data compression selection	Enable bidirectional compression	yes	"H3
V.42*bis* maximum string length	n=250	no	"O250

&F -- FETCH FACTORY CONFIGURATION PROFILE FROM ROM

In addition to storing a copy of the configuration settings in nonvolatile RAM, the modem also has a copy of the original factory settings in ROM. The **&F** command lets you restore the modem to its initial factory settings by copying the information from ROM into the S registers. Unlike the **Z** command (described on page 8-7), the **&F** command restores all the S registers, not just those stored in nonvolatile RAM. Here's the format of the **&F** command:

AT &F

Table 8-1 lists the values restored by the **&F** command.

&V -- VIEW ACTIVE AND STORED CONFIGURATION PROFILES

The **&V** command reports the active configuration profile of the modem, the stored configuration profile (stored with the **&W** command), and the phone number stored by the **&Z** command (described in Chapter 4). Here's the format of the **&V** command:

AT &V

The active and stored configuration profiles and the phone numbers are displayed in the following form:

```
ACTIVE PROFILE:

B1 E1 L2 M1 T Q0 V1 X4 Y0 &C1 &D2 &G0 &J0 &L0 &P0 &S0 &Y0
 A3 %A013  C0 %C1 %E1  G0  J0  K5  N3  Q3  T00  V2  X0 -J1 "H3 "O250
S00:000 S01:000 S02:043 S03:013 S04:010 S05:008 S06:002 S07:055
S08:002 S09:006 S10:014 S11:70 S12:050 S18:000 S25:005 S26:001

STORED PROFILE 0:

 A3 %A013  C0 %C1 %E1  G0  J0  K5  N3  Q3  T00  V2  X0 -J1 "H3 "O250
S00:000 S07:055 S11:70 S18:000 S21:048 S22:118 S23:027 S25:005 S26:001 S27:064

STORED PROFILE 1:

 A3 %A013  C0 %C1 %E1  G0  J0  K5  N3  Q3  T00  V2  X0 -J1 "H3 "O250
S00:000 S07:055 S11:70 S18:000 S21:048 S22:118 S23:027 S25:005 S26:001 S27:064

TELEPHONE NUMBER:

&Z0
```

&W -- WRITE ACTIVE CONFIGURATION PROFILE TO NONVOLATILE RAM

The **&W** command writes a subset of the parameters for the modem's active configuration profile into the modem's NVRAM. The information in NVRAM is retained even when you turn off the modem and can be recalled later using the **Z** command (described one page 8-7). Here's the format of the **&W** command:

AT &W*n*

The *n* parameter lets you save two configurations (0 or 1). If you don't specify a value for *n*, the 0 configuration is saved.

The **&W** command saves these S registers:

S0	S7	S11	S14	S18
S21	S22	S23	S25	S26
S27				

See later sections of this chapter for specific information about these S registers.

The **&W** command also saves the settings for these commands:

B	E	L	M	P
Q	T	V	X	Y
&C	&D	&G	&L	&P
&S	&T4	&T5	\A	\C
\G	\J	\K	\N	\Q
\T	\V	\X	-J	%A
%C	%E	"H		

&Y -- DESIGNATE STORED PROFILE TO USE AT STARTUP

The **&Y** command determines which stored configuration profile is restored automatically when you turn on the modem and when you issue the **Z** command (described in the next section). Here's the format of the **&Y** command:

AT &Y*n*

The *n* parameter (0 or 1) determines which stored profile is restored.

AT&Y or AT&Y0	Designates that profile 0 (previously saved using **&W0**) is used at startup. This is the factory setting.
AT&Y1	Designates that profile 1 (previously saved using **&W1**) is used at startup.

Z -- FETCH CONFIGURATION PROFILE FROM NONVOLATILE RAM

The **Z** command resets the modem's configuration profile by copying all the information stored in nonvolatile RAM for a selected configuration profile to the corresponding S registers and all the other parameters to their factory settings. Here's the format of the Z command:

AT Z*n*

The *n* parameter (0 or 1) selects the configuration profile you want to restore. (To save a configuration profile in nonvolatile RAM, use the **&W** command, described on page 8-6.)

The **Z** command restores the following S registers to the values they had when you last invoked the **&W** command (or to their original values if you never invoked the **&W** command):

S0	S11	S14	S18	S21
S22	S23	S25	S26	S27

It also restores the settings of these commands:

B	E	L	M	P
Q	T	V	X	Y
&C	&D	&G	&L	&P
&S	&T4	&T5	\A	\C
\G	\J	\K	\N	\Q
\T	\V	\X	-J	%A
%C	%E	"H		

Table 8-1 notes the parameters that are initialized from NVRAM. Table 8-2 briefly tells which S registers control which parameters. When you invoke the **Z** command, these options are restored to the values they had when you last invoked the **&W** command.

S -- READ AND WRITE S REGISTERS

The modem settings are maintained in 28 modem locations called S registers. These S registers are labeled S0 through S27. When you invoke any of the modem commands in this manual, the modem changes S register values to reflect the commands you entered. This lets you set up the modem without learning the individual bit fields in the corresponding S registers.

You can also read and write the S registers directly. You probably won't need to do this often, because most of the modem features are associated with specific AT commands. But some of the S registers control features that aren't available with other modem commands. The next two sections describe how to read and write the S registers. Later sections in this chapter describe the features that each S register controls and lists the commands (if any) associated with each register.

Reading an S register

You can use the **S** command to read the contents of an S register. Here's the format of a read command:

AT S*n*?

The *n* parameter is a number from 0 to 27 that indicates the S register you want to read.

In response to the **S** command, the modem displays a three-digit decimal number indicating the contents of the requested register. It also displays the characters OK on the next line.

Example. This command reads the contents of register S2:

```
ATS2?
```

The modem responds:

```
043
OK
```

Example. You can place multiple read commands on the same line. In this case, the modem displays the contents of all the registers you request, separated by a carriage return and line feed. This command reads the contents of S0 and S2:

```
ATS0?S2?
```

The modem responds:

```
003
043
OK
```

Writing an S register

You can also use the **S** command to write values to S registers. Here's the format of a write command:

AT S*n*=*value*

The *n* parameter is a number from 0 to 27 that indicates the S register you want to write to. The *value* parameter is the value you want to set the S register to. The descriptions of the individual S registers later in this chapter list the range of values that you can specify for each S register.

Example. This command sets the S0 register to 4:

```
ATS0=4
```

The modem responds:

```
OK
```

Specifying S registers

The modem always remembers the last S register you read from or wrote to. The register it remembers is the "current" S register. Thus, if you want to perform another read or write operation on the same register, you can do so without specifying its name.

- To read the last S register you referred to, you can omit the S*n* part of the command and use only the ?.

- To write the last S register you referred to, you can omit the S*n* part of the command and use only the =*value*.

You can also make one of the S registers the current register without reading or writing it. Do this by issuing the **S***n* command without the =. Then you can read or write that register without referring to it specifically.

Example. This command sets S0 as the current register:

```
ATS0
```

The modem responds:

```
OK
```

This command sets S0 to 3:

```
AT=3
```

The modem responds:

```
OK
```

This command reads the S0 register:

```
AT?
```

The modem responds:

```
003
OK
```

S REGISTERS

The rest of this chapter describes the contents of the S registers. Table 8-2 summarizes the register contents.

▼ **NOTE** *You can set any of the S registers to a value from 0 to 255. The range of valid values, however, is not always 0 to 255. For some registers, setting the register to a value greater than its allowable range can cause the modem to operate incorrectly. The following register descriptions give the valid range for each register.*

S0 -- Modem auto answer

The value in this register indicates whether the modem will answer a call. Setting S0 to 0 disables the modem's auto answer capability. Setting S0 to any valid nonzero number causes the modem to answer on the ring specified in SETUP. See "Answering incoming calls" in the SatisFAXtion installation guide for details about how the fax modem answers the phone.

Valid range: 0 to 255

Factory setting: 0

Table 8-2 *Summary of S register contents*

Register	Range	Factory Setting	Description
S0*	0-255 rings	0	Modem auto answer
S1	0-255 rings	0	Ring count
S2	0-127 ASCII	43	Escape sequence character
S3	0-127 ASCII	13	Carriage return character
S4	0-127 ASCII	10	Line feed character
S5	0-32, 127 ASCII	8	Backspace character
S6	0-255 sec	2	Time to wait before blind dialing
S7*	1-255 sec	60	Time to wait for carrier after dialing
S8	0-255 sec	2	Time to pause for each comma
S9	1-255 1/10 sec	6	Carrier detect response time
S10	1-255 1/10 sec	14	Delay between lost carrier and hangup
S11*	0-255 1/1000 sec	70	Dialing speed
S12	0-255 1/50 sec	50	Escape sequence guard time
S13	N/A	N/A	Not used
S14*	N/A	138	Bit-mapped options
S15	N/A	N/A	Not used
S16	N/A	0	Modem test options
S17	N/A	N/A	Not used
S18*	0-255 sec	0	Maximum time for diagnostic tests
S19	N/A	N/A	Not used
S20	N/A	N/A	Not used
S21*	N/A	48	Bit-mapped options
S22*	N/A	118	Bit-mapped options
S23*	N/A	11	Bit-mapped options
S24	N/A	N/A	Not used
S25*	0-255 1/100 sec	5	Time DTR must remain off
S26*	0-255 1/100 sec	1	RTS-to-CTS delay
S27*	N/A	64	Bit-mapped options

* The contents of these registers are stored in nonvolatile RAM. If you change the registers, you can store the changes permanently by invoking the **&W** command.

S1 -- Ring count

This is a read-only register that the modem increments each time it detects a ring signal on the phone line. The modem clears the S1 value if no rings occur for eight seconds.

Valid range: 0 to 255 rings

Factory setting: 0

S2 -- Escape sequence character

The S2 register holds the ASCII value of the escape sequence character. This is the character you can enter to return the modem from on-line to command mode. The factory setting (43) represents the + character.

Although you can set S2 to any value from 0 to 255, values greater than 127 disable the escape sequence feature. In this situation, the only way the modem can return from on-line to command mode is by having the remote modem hang up (causing an on-to-off transition of the DTR signal) while the **&D1**, **&D2**, or **&D3** command is in effect.

Valid range: 0 to 127

Factory setting: 43 (ASCII +)

S3 -- Carriage return character

The S3 register holds the ASCII value of the carriage return character. This character terminates both command lines and result codes.

Valid range: 0 to 127

Factory setting: 13 (ASCII carriage return character)

S4 -- Line feed character

The S4 register holds the ASCII value of the line feed character. The modem sends this character, following the carriage return character, after displaying each verbal result code.

Valid range: 0 to 127

Factory setting: 10 (ASCII line feed character)

S5 -- Backspace character

The S5 register holds the ASCII value of the backspace character. When entered, the backspace character blanks the character just before the cursor, moves the cursor back one character, and deletes the last character in the command buffer.

Don't set the backspace character to a printable ASCII character (ASCII codes 33 through 126). If you do, the modem won't recognize the character as anything but a backspace character.

The modem processes the backspace character by performing these operations:

- Echoes the backspace character to the screen.
- Sends an ASCII space character to the screen.
- Sends another backspace character to the screen.

Because the modem sends three characters for each backspace character you type, the backspace takes three times as long to process as any other character. Because of the extra time required, you should not enter multiple backspace characters back-to-back when in command mode. If you do, the modem might not be able to handle them. This situation can prevent the repeat key function from working with the backspace key.

Valid range: 0 through 32, 127

Factory setting: 08 (ASCII backspace character)

S6 -- Time to wait before blind dialing

The value in the S6 register specifies the amount of time the modem waits after picking up the phone before dialing the number. The purpose of this delay is to wait for a dial tone. The effect of the value in the S6 register depends on the setting of the **X** command (described in Chapter 3).

If you invoke the **X0**, **X1**, or **X3** command, the modem waits for the amount of time specified in the S6 register, even if a dial tone occurs before that. Even though S6 can be set to any value between 0 and 255 seconds, the modem always waits at least two seconds, even if you set S6 to a smaller value.

If you invoke the **X2** or **X4** command (**X4** is the factory setting), the modem disregards the value in the S6 register. Instead, it waits for five seconds, then checks for a dial tone. If the dial tone is present, the modem dials the number immediately. If no dial tone is present, the modem issues the NO DIALTONE result code and hangs up.

Valid range: 0 to 255 seconds

Factory setting: 2 seconds

S7 -- Time to wait for carrier after dialing

If you use the extended result code command **X3** or **X4** (**X4** is the factory setting), the modem in originate mode waits for a ringback (the ringing sound you hear when calling someone else). The value in S7 specifies the amount of time the modem will wait.

The modem also uses the value in S7 as the amount of time to wait for a carrier from the remote modem before hanging up. Because the modem looks for the carrier even if it can't detect a ringback, the combination of ringback waiting and carrier waiting can result in a total wait time that is twice as long as the value specified in S7.

When the modem is answering a call, it uses the value in S7 as the time to wait for a carrier only. There is no ringback associated with answering a call.

Also, the value in the S7 register determines how long to wait for a subsequent dial tone when the **W** dial modifier is included. It doesn't affect the time the modem waits for a dial tone after initially going off-hook (the S6 register governs that). The value in S7 applies to a subsequent dial tone (such as dialing 9 for an outside line and waiting for another dial tone).

If you've configured your modem for leased line operation (using the **&L1** or **&L2** command), the value in S7 has no effect. Instead, the modem will wait indefinitely for the carrier, giving the operators on each end of the leased line time to establish the connection.

Valid range: 1 to 255 seconds

Factory setting: 60 seconds

S8 -- Time to pause for each comma

When you include the comma (,) dial modifier in a phone number you're dialing with the **D** command, the modem pauses before dialing the numbers after the comma. (See Chapter 4 for more information about the comma dial modifier.) The value in S8 specifies the amount of time the modem waits whenever a comma appears in the dial string.

Valid range: 0 to 255 seconds

Factory setting: 2 seconds

S9 -- Carrier detect response time

The S9 register specifies how long a carrier signal must be present before the modem turns the data carrier detect (DCD) signal on.

The value in S9 affects the time required to recognize a signal as a carrier. It has no effect once the carrier has been recognized. Increasing the S9 value increases the time the modem takes to recognize that a carrier is really a carrier, but it decreases the chance that the modem will detect a false carrier, such as one caused by noise from busy signals or voices.

Valid range: 1 to 255 1/10th-second intervals

Factory setting: 6 (0.6 seconds)

S10 -- Delay between lost carrier and hangup

The S10 register specifies how long the modem waits after the carrier is lost (the remote modem hangs up) before disconnecting from connections at 300 bps. A delay lets the modem recover from momentary losses of the carrier without disconnecting. Specifying the maximum value (255) causes the modem to ignore any carrier losses and to function as if the carrier were always present.

If the S10 value is smaller than the S9 value, any loss of carrier will cause a disconnect. This happens because when the modem momentarily loses its carrier and then detects it again, it waits for the amount of time specified in S9 before reconnecting. If the wait-to-connect time specified in S9 is greater than the wait-to-hang-up time specified in S10, the modem will disconnect (hang up) before it can re-establish the connection. When S10 is greater than S9, the length of a carrier loss that the modem can tolerate is the difference between S10 and S9.

Valid range: 1 to 255 1/10th-second intervals

Factory setting: 14 (1.4 seconds)

S11 -- Dialing speed

The S11 register specifies how quickly numbers are dialed on tone-dial phones. (For tone-dial phones, dialing speed is determined by the duration of tones and duration of silence between tones.)

Valid range: 0 to 255 milliseconds

Factory setting: 70 milliseconds

S12 -- Escape sequence guard time

The S12 register specifies the escape sequence guard time. This is a delay (during which no characters must be received) that must occur immediately before and immediately after an escape sequence (normally +++). Also, the time between escape-code characters must be less than the guard time. If the time before and after the escape sequence isn't long enough, or if the time between escape characters is too long, the modem won't recognize the escape sequence and won't switch the modem from on-line to command mode.

If you specify a value of 0, the modem doesn't enforce a guard time. Thus, when you enter three consecutive escape characters, regardless of the timing, the modem will switch to command mode. If you wish to select a guard time, you must use a minimum value of 20.

Valid range: 0 or 20 to 255 1/50th-second (20-millisecond) intervals

Factory setting: 50 (1 second)

S14 -- Bit-mapped options

The individual bits in the S14 register indicate the settings of several modem options. You can determine the current settings of the bits in S14 by reading the register (**ATS14?**) and translating the resulting decimal number into a binary value. You can change the settings of the bits in S14 by determining a binary value that sets and clears the appropriate bits, converting that value to a decimal number, and writing the decimal number into the register (**ATS14=*decimal value***). The bits and their corresponding options are as follows.

Bits

7	6	5	4	3	2	1	0

Bit Description

Bit 0 Reserved.

Bit 1 Echo mode. See the **E** command in Chapter 6.

0 Echo disabled.

1 Echo enabled (factory setting).

Bit 2 Result codes. See the **Q** command in Chapter 3.

0 Result codes enabled (factory setting).

1 Result codes disabled.

Bit	Description
Bit 3	Verbal or numeric result codes. See the **V** command in Chapter 3. 0 Numeric result codes. 1 Verbal result codes (factory setting).
Bit 4	Reserved.
Bit 5	Pulse or tone dial. See the **P** and **T** dial modifiers in Chapter 4. 0 Tone dial (factory setting). 1 Pulse dial. This bit remains set or cleared based on the most recently used **P** or **T** modifier in the dial string of a **D** (dial) command. A **P** sets the bit, and a **T** clears the bit. Subsequent **D** commands that omit the **P** or **T** modifiers will use the dialing method indicated by the current setting of the bit.
Bit 6	Reserved.
Bit 7	Originate or Answer mode. See the **A** command (Chapter 5), the **D** command (Chapter 4), and the **R** dial modifier (Chapter 4). 0 Answer mode. 1 Originate mode (factory setting).

S16 -- Modem test options

The individual bits in the S16 register indicate the settings of several modem test options. This register isn't saved in nonvolatile RAM. The **&T0** command (described in Chapter 9) terminates any test in progress and resets the S16 register to 0. Only one of the tests can be performed at a time.

The bits and their corresponding options are as follows.

Bits

7	6	5	4	3	2	1	0

Bit Description

Bit 0 Local analog loopback. See the **&T1** command in Chapter 9.

0 Disabled (factory setting).

1 Enabled.

Bit 1 Reserved.

Bit 2 Local digital loopback. See the **&T3** command in Chapter 9.

0 Disabled (factory setting).

1 Enabled.

Bit 3 Status of remotely-issued remote digital loopback test. See the **&T4** and **&T5** commands in Chapter 9.

0 Loopback off (factory setting).

1 Loopback on.

Bit 4 Status of locally-issued remote digital loopback. See the **&T6** command in Chapter 9.

0 Disabled (factory setting).

1 Enabled.

Bit	Description
Bit 5	Status of locally-issued remote digital loopback with self-test. See the **&T7** command in Chapter 9. 0 Disabled (factory setting). 1 Enabled.
Bit 6	Status of local analog loopback with self-test. See the **&T8** command in Chapter 9. 0 Disabled (factory setting). 1 Enabled.
Bit 7	Reserved.

S18 -- Maximum time for diagnostic tests

The S18 register sets the maximum amount of time that the diagnostic tests will run. Unless you stop a diagnostic test by invoking the **&T0** command (described in Chapter 9), the test will remain active for the amount of time specified in the S18 register. When the time expires, the modem stops the test.

Specifying a value of 0 disables the test timer. In this case, any diagnostic test will continue until you enter the **&T0** command to stop it.

Valid range: 0 to 255 seconds

Factory setting: 0 (timer is disabled)

S21 -- Bit-mapped options

The individual bits in the S21 register indicate the settings of several modem options. You can determine the current settings of the bits in S21 by reading the register (**ATS21?**) and translating the resulting decimal number into a binary value. You can change the settings of the bits in S21 by determining a binary value that sets and clears the appropriate bits, converting that value to a decimal number, and writing the decimal number into the register (**ATS21=*decimal value***).

The bits and their corresponding options are as follows.

Bits

7	6	5	4	3	2	1	0

Bit	Description
Bit 0	Reserved
Bit 1	Serial communication rate. See the description later in this chapter of bits 1, 2, and 3 of register S23.
Bit 2	CTS options. 0 CTS tracks RTS (factory setting) 1 CTS always on.
Bits 3,4	DTR options. See the **&D** command in Chapter 6. 0 Modem ignores DTR. 1 Modem returns to command state when on-to-off transition of DTR occurs. 2 Modem hangs up when on-to-off transition of DTR occurs (factory setting). 3 Modem initializes when on-to-off transition of DTR occurs.
Bit 5	DCD options. See the **&C** command in Chapter 6. 0 DCD always on. 1 DCD on indicates valid data carrier (factory setting).
Bit 6	DSR options. See the **&S** command in Chapter 6. 0 DSR always on (factory setting). 1 Modem is off-hook in data mode.

Bit	Description
Bit 7	Long space disconnect. See the **Y** command in Chapter 6.
	0 Disabled (factory setting).
	1 Enabled.

S22 -- Bit-mapped options

The individual bits in the S22 register indicate the settings of several modem options. You can determine the current settings of the bits in S22 by reading this register (**ATS22?**) and translating the resulting decimal number into a binary value. You can change the settings of the bits in S22 by determining a binary value that sets and clears the appropriate bits, converting that value to a decimal number, and writing the decimal number into the register (**ATS22=*decimal value***). The bits and their corresponding options are as follows.

Bits

7	6	5	4	3	2	1	0

Bit	Description
Bits 0,1	Speaker volume. See the **L** command in Chapter 6.
	0 Low volume.
	1 Low volume.
	2 Medium volume (factory setting).
	3 High volume.
Bits 2,3	Speaker on or off. See the **M** command in Chapter 6.
	0 Speaker always off.
	1 Speaker on until modem detects carrier (factory setting).
	2 Speaker always on.
	3 Speaker on until modem detects carrier but off during dialing.

Bit	Description
Bits 4, 5,6	Result code options. See the **X** command in Chapter 3.

0 The modem goes off-hook, waits the amount of time specified in S6, and dials regardless of the presence or absence of a dial tone. It sends a CONNECT message when the connection is established (**X0** command).

1 Undefined.

2 Undefined.

3 Undefined.

4 The modem goes off-hook, waits the time specified in S6, and dials regardless of the presence or absence of a dial tone. It sends a CONNECT, CONNECT 1200, or CONNECT 2400 message when the connection is established (**X1** command).

5 Same as option 4, except the modem waits up to five seconds for a dial tone before dialing (**X2** command).

6 Same as option 4, except the modem can detect a busy signal and return the BUSY code (**X3** command).

7 Same as option 4, except the modem waits up to five seconds for a dial tone and can detect a busy signal (**X4** command). This is the factory setting.

Bit 7 Make/break pulse dial ratio. See the **&P** command in Chapter 6.

0 39/61 ratio, used in the United States and Canada (factory setting).

1 33/67 ratio, used in the United Kingdom and Hong Kong.

S23 -- Bit-mapped options

The individual bits in the S23 register indicate the settings of several modem options. You can determine the current settings of the bits in S23 by reading this register (**ATS23=?**) and translating the resulting decimal number into a binary value. You can change the settings of the bits in S23 by determining a binary value that sets and clears the appropriate bits, converting that value to a decimal number, and writing the decimal number into the register (**ATS23=*decimal number***). The bits and their corresponding options are as follows.

Bits

7	6	5	4	3	2	1	0

Bit	Description
Bit 0	Determines whether modem should accept requests from a remote modem for a remote digital loopback test. See the **&T4** and **&T5** commands in Chapter 9. 0 Ignore remote digital loopback request. 1 Accept remote digital loopback request (factory setting).
Bits 1, 2,3	Serial communication rate (DTE rate). See the **AT** attention code in Chapter 3. These bits are used in conjunction with bit 1 of S21 to set the serial data communication rate of the modem. **When bit 1 of S21 is set to 0**, bits 1, 2, and 3 of S23 indicate the current communications rate as follows: 0 0 to 300 bps. 1 1200 bps. 2 2400 bps. 3 4800 bps. 5 9600 bps. 6 19,200 bps. 7 38,400 bps.

Bit	Description
Bits 1, 2,3	**When bit 1 of S21 is set to 1**, bits 1, 2, and 3 of S23 set the communications rate as follows: 0 12,000 bps. 1 14,400 bps. 2 57,600 bps.
Bits 4,5	Parity. See the **AT** attention code in Chapter 3. 0 Even parity. 1 Space parity/no parity (factory setting). 2 Odd parity. 3 Mark parity.
Bits 6,7	Guard tones. See the **&G** command in Chapter 6. 0 No guard tones (factory setting). 1 550-Hz guard tone. 2 1800-Hz guard tone. 3 Reserved.

S25 -- Time DTR must remain off

The S25 register specifies how long that a change in DTR (either on or off) must persist before the modem recognizes the change.

The S25 value is interpreted as units of 1/100th seconds.

Valid range: 0 to 255 1/100th seconds

Factory setting: 5 (.05 seconds)

S26 -- RTS-to-CTS delay

The S26 register specifies how long the modem waits after an off-to-on transition of the RTS signal before asserting the CTS signal.

Valid range: 0 to 255 1/100th seconds

Factory setting: 1 (.01 seconds)

S27 -- Bit-mapped options

The individual bits in the S27 register indicate the settings of several modem options. You can determine the current settings of the bits in S27 by reading this register (**ATS27=?**) and translating the resulting decimal number into a binary value. You can change the settings of the bits in S27 by determining a binary value that sets and clears the appropriate bits, converting that value to a decimal number, and writing the decimal number into the register (**ATS27=*decimal value***). The bits and their corresponding options are as follows.

Bits

7	6	5	4	3	2	1	0

Bit Description

Bits 0,1 Reserved.

Bits 2,7 Dial-up or leased line selection. See the **&L** command in Chapter 6. Bit 2 (least significant bit) and bit 7 (most significant bit) are used together to select dial-up or leased-line operation, as follows:

0 Dial-up line (factory setting).

1 Leased line.

2 Reserved.

3 Leased line autoconnect.

Bit 3 Reserved.

Bits 4,5 Reserved.

Bit	Description

Bit 6 Protocol when using 300 bps and 1200 bps modem rates.

Bit 6	Modem Rate	Protocol
0	300 bps	CCITT V.22
0	1200 bps	CCITT V.21
1	300 bps	Bell 103
1	1200 bps	Bell 212A

The *n* parameter of the **B** command (described in Chapter 6) sets this bit.

Bit 7 See bits 2,7 above.

Chapter 9. Diagnostic commands

INTRODUCTION

The modem includes several diagnostic commands that run internal modem diagnostic tests. These tests help you isolate the causes of communication failures. This chapter describes the diagnostic commands.

As with all modem commands, the diagnostic tests in this chapter must be invoked from command mode. However, to use the local or remote digital loopback tests, you must first establish a phone connection. Therefore, to invoke the commands for remote or digital loopback, you must first enter the escape sequence (the default is +++) to return to command mode or cause an on-to-off transition of the DTR signal (if you have invoked the **&D1** command).

▼ **NOTE** *Your communication program usually provides a way to toggle the DTR signal (causing an on-to-off transition) so you can switch from on-line mode to command mode. For example, with Procomm you enter ALT-H to switch to command mode. See your communication program manual for information on how to switch to command mode.*

SETTING THE TESTING TIME

Setting register S18 (described in Chapter 8) to a nonzero value sets the length of time that any diagnostic test will run. When the time (from 1 to 255 seconds) elapses, the modem automatically halts the test and returns to command mode.

Setting S18 to zero disables the test timer. The diagnostic test will then run until you enter the **&T0** command to halt the test.

&T0 -- TERMINATE TEST IN PROGRESS

The **&T0** command terminates any diagnostic test that's in progress. Here's the format of the **&T** command:

AT &T

or

AT &T0

If you include multiple commands in one command line, make sure the **&T0** command is the last one. The modem will ignore commands that follow the **&T0** (or **&T**) command on the same line.

If you're running the local analog loopback (**&T1**) or remote digital loopback (**&T7**) tests, you must enter the escape sequence (usually +++) to return to command mode before invoking the **&T0** command. See Chapter 3 for information about the escape sequence.

&T1 -- LOCAL ANALOG LOOPBACK

The **&T1** command initiates a local analog loopback test. This test checks the data path from the computer to the modem and from the modem to the computer. It does this by reading information from the transmit data (TD) line and echoing that information back through the receive data (RD) line. After the test starts, you type information at the keyboard, and the modem echoes that information back to the screen. If the information appears exactly as you typed it, the modem passes the test.

If the test fails, either your computer or your modem is at fault.

Here's the format of the **&T1** command:

AT &T1

If your modem is on-line when you invoke this command, the modem will lose the carrier.

The test ends when the time limit in the S18 register expires, or when you invoke the **&T0** command. Before invoking the **&T0** command, you must enter the escape sequence (usually +++) to return to command mode.

Example. In this example, you set the test timer to 0 (disabling it) and invoke the local analog loopback test. After testing the modem for a while, you return the modem to command mode and stop the test.

Enter this command to set register S18 (the test timer) to 0 and start the test:

```
AT S18=0 &T1
```

The modem responds with a connect message or code. You can now begin entering characters at the keyboard. The characters should appear on the screen as you type them. For example:

```
A rose isn't flower enough.
```

When you finish testing, enter the escape sequence to return the modem to command mode:

```
+++
```

The modem responds with:

```
OK
```

End the test with this command:

```
AT&T0
```

The modem responds with:

```
OK
```

&T3 -- LOCAL DIGITAL LOOPBACK CONNECTION

The **&T3** command initiates a local digital loopback connection. This connection causes your local modem to transmit any data received from a remote modem back to that remote modem. This operation lets the remote modem perform a digital loopback test by sending a known string of data to your local modem and comparing it with the data it receives back from your modem.

Here's the format of the **&T3** command:

AT &T3

If the remote modem is fully compatible with CCITT V.54, you don't need to invoke the **&T3** command. A CCITT V.54 compatible modem can perform the remote digital loopback test without requiring you to invoke a special command (although you can turn off your modem's ability to participate in the remote digital loopback with the **&T5** command). The **&T3** command lets you set up a local digital loopback connection when the remote modem isn't fully CCITT V.54 compatible.

Example. In this example, the local modem and a remote modem are already connected in normal mode. The remote operator wants to perform a remote digital loopback test on the remote modem and tells you (via another phone) to set your modem for a local digital loopback connection and turn off the timer. You do this as follows:

Enter this escape sequence to return to command mode:

+++

The modem responds:

```
OK
```

Enter this command to set register S18 (the test timer) to 0 and set up the local digital loopback connection:

```
AT S18=0 &T3
```

The modem responds:

```
OK
```

The remote operator finishes the remote digital loopback test and notifies you. You then end the local digital loopback connection by entering this command:

```
AT&T0
```

The modem responds:

```
OK
```

&T4 -- GRANT REMOTE DIGITAL LOOPBACK FROM REMOTE

The **&T4** command lets your modem participate in remote digital loopback tests initiated by remote modems. This is the factory setting of the modem. Here's the format of the **&T4** command:

AT &T4

&T5 -- DENY REMOTE DIGITAL LOOPBACK FROM REMOTE

The **&T5** command prevents your modem from participating in remote digital loopback tests initiated by remote modems. Here's the format of the **&T5** command:

AT &T5

&T6 -- REMOTE DIGITAL LOOPBACK

The **&T6** command starts a remote digital loopback test. This test requires your modem to be connected to a remote modem. The test checks your computer, your local modem, the phone line, and the remote modem. It does this by letting you type characters at the keyboard, which are then sent to the remote modem. The remote modem, if set up properly, sends those characters back to your local modem, which compares them with the characters you typed. If the information appears on your screen exactly as you typed it, your computer, your modem, the phone line, and the remote modem passed the test.

If the test fails, you'll need to run additional tests to isolate the problem. In particular, you should run the local analog loopback test (**&T1**) on both the local and remote modems. If those tests pass, it's likely that the phone line is at fault; report the problem to the phone company.

Here's the format of the **&T6** command:

AT &T6

To perform a remote digital loopback test, follow these steps:

1 **Establish a connection with a remote modem.**

2 **Return to command mode**, either by entering the escape sequence (normally +++) or by causing an on-to-off transition of the DTR signal (if you've previously invoked the **&D1** command).

3 **Enter the &T6 command.**

4 **Type characters at the keyboard.** These characters will be echoed on your screen. If the information appears on your screen exactly as you typed it, your computer, your modem, the phone line, and the remote modem passed the test.

5 **End the test, either by entering the &T0 command or by letting the test timer expire.**

▼ **NOTE** *To perform a remote digital loopback test, the remote modem must either be CCITT V.54 compatible or the **&T3** command must have been entered from the remote computer to set up a remote loopback connection. (See the description of the **&T3** command on page 9-4.)*

Also, the remote modem must be set to grant a remote digital loopback test. This condition is the factory setting for PureData modems and is set with the **&T4** *command (described on page 9-5).*

Example. This example assumes the local modem is already in diagnostics mode and connected to a remote modem. Disable the test timer and invoke the remote digital loopback test. After testing for a while, return the modem to command mode and end the test.

Enter this escape sequence to return to command mode:

```
+++
```

The modem responds:

```
OK
```

Enter this command to set register S18 (the test timer) to 0 and to start the remote digital loopback test:

```
AT S18=0 &T6
```

You can now type information at the keyboard. The same characters should be echoed to your screen. For example:

```
A rose isn't flower enough.
```

When you've finished testing your modem, enter the escape sequence to return the modem to command mode:

```
+++
```

The modem responds:

```
OK
```

Enter this command to end the test:

```
AT&T0
```

The modem responds:

```
OK
```

&T7 -- REMOTE DIGITAL LOOPBACK WITH SELF-TEST

The **&T7** command initiates a remote digital loopback with self-test in accordance with CCITT Recommendation V.54. The test checks the remote modem and the phone line. This test requires your modem to be connected to a remote modem.

This remote digital loopback with self-test causes the local modem to send an internally-generated data pattern to the remote modem. The remote modem, when set up properly, sends the same information back to the local modem. The local modem compares the information received with the information sent and increments a counter each time it detects an error. At the end of the test, the modem displays a three-digit number indicating the number of errors that occurred during the test.

If the error count is zero, the remote modem and phone line passed the test. If the error count is nonzero, you'll need to run additional tests to isolate the problem. In particular, you should run the local analog loopback test (**&T1**) on both the local and remote modems. If those tests pass, it is likely that the phone line is at fault; report the problem to the phone company.

Here's the format of the **&T7** command:

AT &T7

To perform a remote digital loopback with self-test, follow these steps:

1 **Establish a connection with a remote modem.**

2 **Return to command mode,** either by entering the escape sequence (normally +++) or by causing an on-to-off transition of the DTR signal (if you've previously invoked the **&D1** command).

3 **Enter the &T7 command.**

4 **End the test, either by entering the escape sequence and the &T0 command or by letting the test timer expire.**

▼ **NOTE** *To perform a remote digital loopback test, the remote modem must either be CCITT V.54 compatible or the* ***&T3*** *command must have been entered from the remote computer to set up a remote loopback connection. (See the description of the* ***&T3*** *command on page 9-4.)*

Also, the remote modem must be set to grant a remote digital loopback test. This condition is the factory setting for PureData modems and is set with the **&T4** *command (described on page 9-5).*

Example. This example assumes the local modem is already connected to a remote modem. You should then disable the test timer and invoke the remote digital loopback with self-test. After testing for a while, end the test.

Enter this escape sequence to return to command mode:

```
+++
```

The modem responds:

```
OK
```

Enter this command to set register S18 (the test timer) to 0 and to start the remote digital loopback with self-test diagnostic:

```
AT S18=0 &T7
```

Let the test run for a minute or so, then enter this command to end the test:

```
AT&T0
```

If no errors occurred, the modem responds:

```
000
OK
```

&T8 -- LOCAL ANALOG LOOPBACK WITH SELF-TEST

The **&T8** command initiates a local analog loopback with self-test in accordance with CCITT V.54 recommendation. This test checks the modem's transmit and receive circuits. It does this by causing the modem to send an internally-generated data pattern through the transmit circuit. The data is not sent to a remote modem but instead is looped back through the modem's receive circuit. The modem compares the transmitted data with the received data and increments a counter each time it detects an error. At the end of the test, the modem displays a three-digit number indicating the number of errors that occurred during the test. If the error count is zero, the modem passed the test. A nonzero count indicates a problem with your modem. Here's the format of the **&T8** command:

AT &T8

The modem should be off-line when you invoke this command. If the modem is on-line, the modem will lose the carrier.

The test ends when the time limit in the S18 register expires or when you invoke the **&T0** command.

Example. In this example, you set the test timer to 0 (disabling it) and then invoke the local analog loopback with self-test. After testing the modem for a while, end the test.

Enter this command to set register S18 (the test timer) to 0 and to start the test:

```
AT S18=0 &T8
```

Let the test run for a minute or so, then enter this command to end the test:

```
AT&T0
```

If no errors occurred, the modem responds as follows:

```
000
OK
```

I -- RETURN PRODUCT CODE AND STATUS

The **I** command returns your modem's product code or a checksum computed on the modem's ROM. (PureData Customer Service uses this information to determine the version of your modem and whether or not the on-board ROM is corrupted.) This test is not related to the other diagnostic tests described in this chapter and is not affected by the test timer (the S18 register). The **I** command returns its results immediately. Here's the format of the **I** command:

AT I*n*

The *n* parameter determines what information the command returns:

ATI or **ATI0** — The modem displays its product code on your computer's monitor. The product code is three ASCII characters, followed by a carriage return and line feed. The first two characters of the product code indicate the maximum rate at which the modem operates.

ATI1 — The modem displays a checksum computed on the modem's ROM, followed by a carriage return and line feed. The checksum takes the form of three ASCII numeric characters.

ATI2 — The modem computes a checksum of the modem's ROM and displays the message OK or ERROR to indicate the status of the checksum.

ATI3 — The modem lists its ROM components, including the software revision number. The format for this information is:

```
XX-XXXXX-YY
```

where `XX-XXXXX` is the ROM part number and `YY` is the revision level (in two digits).

ATI4 — The modem reports its capabilities in a form intended to be read only by communications software.

Appendix A. COM port information

INTRODUCTION

This appendix explains COM ports. It also contains technical information about interrupt requests (IRQs).

If you're just curious about COM ports, read the first part of this appendix and skip the technical information. If you're having trouble with COM port conflicts, read the technical section.

WHAT IS A COM PORT?

A COM port consists of circuits (and often a connector) that lets your computer communicate with serial printers, other computers (using modems or SatisFAXtion fax modems), and serial devices such as plotters, mice, local area networks, and custom laboratory equipment. The SatisFAXtion fax modem contains a built-in COM port that is dedicated for data modem use. Because only the data modem uses this COM port, the port has no external connector for plugging in printers, mice, or other devices.

COM PORT NAMES

Each COM port is associated with an I/O address and an interrupt request (IRQ).

Classic bus COM ports

In classic bus computers (PC-, XT-, or AT-compatible), IBM has reserved I/O addresses and IRQs for two COM ports:

- Primary COM port (I/O address 03F8 hex and IRQ 4)
- Secondary COM port (I/O address 02F8 hex and IRQ 3)

Two additional COM ports are available in some situations. See "COM port technical information" on page A-4 for more information.

Micro Channel COM ports

Micro Channel computers have these COM ports.

- SERIAL_1 (I/O address 03F8 hex and IRQ 4)
- SERIAL_2 (I/O address 02F8 hex and IRQ 3)
- SERIAL_3 (I/O address 3220 hex and IRQ 3)
- SERIAL_4 (I/O address 3228 hex and IRQ 3)
- SERIAL_5 (I/O address 4220 hex and IRQ 3)
- SERIAL_6 (I/O address 4228 hex and IRQ 3)
- SERIAL_7 (I/O address 5220 hex and IRQ 3)
- SERIAL_8 (I/O address 5228 hex and IRQ 3)

Notice that SERIAL_2 through SERIAL_8 share IRQ 3. This is not a problem if your communications software supports interrupt sharing because IRQ 3 was designated to be used by multiple serial devices.

CONFIGURING A COM PORT

Before you can use a device (such as the modem capability of the SatisFAXtion fax modem) attached to any serial port, you must configure the COM port properly. How you do this for the SatisFAXtion fax modem depends on the computer you have.

- For Micro Channel computers, use the computer's Reference Diskette to configure the COM port for the SatisFAXtion data modem.

- For classic bus computers, run the SatisFAXtion SETUP program. *First-time Setup* automatically configures the modem's COM port.

DOS recognizes up to two COM ports in PC-, XT-, and AT-compatible computers. (DOS 3.3 and later versions can recognize four COM ports, but only on IBM PS/2 computers that use the Micro Channel bus. The additional COM ports are useful only if the communications software also supports more than two COM ports.)

To distinguish between COM ports, DOS names them. DOS assigns port names (COM1 and COM2) based on the number of COM ports in the computer and the I/O address (03F8 or 02F8) that each port uses. When you turn on or restart your computer, DOS checks first for the primary COM port (I/O address 03F8) and then for the secondary COM port (I/O address 02F8).

If you have one COM port in the computer, DOS always names it COM1, regardless of whether it is the primary or secondary COM port. If you have two COM ports, the primary COM port (03F8) becomes COM1, and the secondary COM port (02F8) becomes COM2.

If you have a classic bus computer with two COM devices in addition to the modem, read the rest of this chapter.

COM PORT TECHNICAL INFORMATION

This section discusses the relationship between COM ports and interrupt requests (IRQs). If the modem is your only serial device or if you're not very technically inclined, skip this section.

What is an IRQ?

An IRQ (interrupt request) is the way a device tells the processor it needs to perform a function. When the device sends an IRQ, the processor stops its current function and takes care of the device's request.

In Micro Channel computers, only one serial device can use IRQ4 (SERIAL_1), but up to seven devices (SERIAL_2 through SERIAL_8) can use IRQ3.

For classic bus computers, each IRQ can handle only one device. If two devices try to use the same IRQ, a conflict occurs that normally prevents both devices from working. Therefore, the number of devices a computer can support is limited to the number of IRQs. Because IBM reserves just two IRQs for COM ports (IRQ3 and IRQ4), the number of COM ports is theoretically limited to two. However, you can add additional COM ports to your computer under some circumstances. The rest of this section discusses how to add a modem (which adds a COM port) to a classic bus computer that already has two COM ports.

Adding extra COM ports to classic bus computers

Two conditions let a computer have more than two COM ports.

- **The device that uses one of the two standard COM ports doesn't use the IRQ associated with that COM port.** The most common instance of this occurs when a serial printer is attached to COM1 or COM2. Most serial printer applications don't use the COM port's IRQ, so that IRQ is available for a different COM port.

  To allow for this situation, the modem can be set up for COM3 or COM4 and use the same IRQ as COM1 or COM2 (see Table A-1). For example, suppose your computer already has COM ports COM1 and COM2, but one of them (let's say COM1) is connected to a serial printer. Because scarcely any serial printer software uses interrupts, the COM1 IRQ (IRQ4) is available. Therefore, you can set up the modem as COM3 using IRQ4.

Unfortunately, many devices that use COM ports **do** use the associated IRQ (a serial mouse is a good example). When a mouse is connected to a COM port, you cannot set up the modem to use the same IRQ.

- **Another IRQ is unused and the COM port hardware and software can take advantage of that IRQ.**

  If both the COM1 and COM2 IRQs are being used, you can set up the modem to use IRQ5 (COM3) or IRQ2 (COM4).

  In addition, the communications software you use with your modem must be able to work using the IRQ you choose and with the corresponding I/O address listed in Table A-1. Some recent communications packages can be set for IRQ2 or IRQ5, but many older packages can handle only IRQ3 and IRQ4.

If your computer already has two COM ports and either of these conditions apply, you can set up the modem as COM3 or COM4.

▼ **CAUTION** *Take care before setting up the modem for IRQ2 or IRQ5. First be sure that no other devices are using the IRQ you choose. For example, many LAN adapter cards use IRQ5 or IRQ3. Also, in an XT-compatible computer, the hard disk controller uses IRQ5. Setting up the modem to use IRQ5 in one of these computers could cause major problems, such as destroying the data on your hard disk.*

Setting up COM3 or COM4 on classic bus computers

▼ NOTE *To use COM3 or COM4, you'll need to use communication software that supports these COM ports.*

If you already have two serial devices, you'll need to set the modem's COM port to COM3 or COM4 as shown in Table A-1.

Table A-1 *COM ports, interrupts, and addresses*

COM port	Interrupt	Address
COM1	IRQ4	03F8-03FF
COM2	IRQ3	02F8-02FF
COM3	IRQ4	03E8-03EF
COM4	IRQ3	02E8-02EF
COM3	IRQ5 †	03E8-03EF
COM4	IRQ2 †	02E8-02EF

† Hard disk controllers in IBM XT computers use IRQ5. You risk destroying data on your hard disk if you use IRQ5 in IBM XT computers. Use IRQ5 and IRQ2 *only* if the communications software supports them and their corresponding I/O addresses and if other devices aren't using them.

Example:

You have two existing serial devices (a mouse and a serial printer) and add a third serial device (the SatisFAXtion data modem). You could set up the COM ports as follows:

Mouse	COM1 (IRQ4)
Printer	COM2 (IRQ3)
Modem	COM4 (IRQ3)

In this example, although COM2 (I/O address 02F8) normally uses IRQ3, it doesn't conflict with the modem because most serial printer applications do not use the serial device's IRQ.

Example:

You have an existing serial device (a mouse) and a local area network board that is set up to use IRQ3. You want to add another serial device (the SatisFAXtion data modem). Your computer is AT-compatible and doesn't have a secondary parallel port which is using IRQ5. You could set up the devices as follows:

Mouse	COM1 (IRQ4)
Network Board	(IRQ3)
Modem	COM3 (IRQ5)

Both the mouse and the network board actively use their IRQs. Therefore, you can't set the modem to use either IRQ3 or IRQ4. However, because your computer is AT-compatible, IRQ5 is probably available (in an XT-compatible, IRQ5 would be used by the hard disk controller). Therefore, you can set up the modem as COM3 using IRQ5.

A second and possibly better solution for this situation is to change the network board's IRQ and then set the modem for COM2 (IRQ3). Most network boards can be set up for a variety of IRQs, and the network software can recognize the different settings. By changing the network board, you can set up the modem as a standard COM2 port that all communication software can recognize. You could set up the devices as follows:

Mouse	COM1 (IRQ4)
Network Board	(IRQ5)
Modem	COM2 (IRQ3)

Keep in mind that if you change the setting of your network board, you'll probably need to run a configuration program to let your network software recognize the network board's new setting.

A-8 COM port information

Appendix B. Technical specifications

Table B-1 *SatisFAXtion data modem technical specifications*

Modem data rate	2400, 1200, and 300 bps.
Error control	LAPM; MNP classes 1 through 4.
Data compression	V.42*bis* when using LAPM error control; MNP class 5 when using MNP error control.
Flow control	XON/XOFF; RTS/CTS.
Data format	Asynchronous, seven or eight data bits, plus start, stop, and parity bits.
Operation	Full- or half-duplex leased/dialup line. Tone or pulse dialing. Auto-answer mode.
NVRAM storage	One phone number, two modem configurations.
Command language	Full Hayes AT command set with extensions for MNP and V.42/V.42*bis*.
Command buffer	40 characters.
Audio monitor	On-board 1-inch speaker.
Approvals	USA: FCC Part 15, Class B, FCC Part 68. Canada: DOC CS-03.
Compatibility	CCITT Standards: V.22bis, V.22, V.21. Bell Standards: 212A, 103.
Line equalization	Fixed compromise equalization, transmit. Adaptive equalization for PSK/QAM, receive.
Self tests	CCITT V.54, including both local and remote analog and digital loopback.

B-2 Technical specifications

Appendix C: If something doesn't work

This appendix lists the most common reasons your data modem can operate incorrectly.

Table C-1 *Symptoms and possible solutions*

Symptom	***Possible solution***
Data modem not answering the phone	Make sure you've turned on the modem's auto answer by setting the S0 register to one or greater. (See Chapter 8 for a description of the S0 register.)
Data modem not receiving characters or "Modem not Responding" message	The communications software might be set up for the wrong COM port. See the communications software manual for information on setting up the software for the data modem. The modem may be set for a COM port already in use. For example, you may have set up the modem for COM1, but your mouse is using COM1. Or the interrupt (IRQ) used by your serial port may conflict with another board's IRQ. See Appendix A for information on COM ports and interrupts.
Data modem won't hang up	You may have set the modem to ignore the data terminal ready (DTR) line (with the &D0 command). Some communications software packages need the DTR line to hang up the modem. To reset the modem so the DTR line isn't ignored, enter this command from the communications software command (or terminal) mode: `AT&D2&W`
Data modem won't work in reliable mode	Either the remote modem doesn't support MNP reliable mode, or the remote modem supports MNP, but it isn't in the correct operating mode. Switch to normal **(\N0)** or auto-reliable **(\N3)** operating mode. Also, the telephone lines may be so poor even MNP can't compensate.

Table C-1 *Symptoms and possible solutions (continued)*

Symptom	*Possible solution*
Data modem won't dial or dials the wrong number	If you're using a telephone that's part of a private branch exchange (PBX), the PBX system may need to be adjusted for a modem. It's also possible that the PBX system won't work with a modem. Ask your PBX representative if you can use a modem. If your PBX system is compatible with modems, ask the representative how to adjust it. You may have set the data carrier detect (DCD) line to be always active (with the &C0 command). Some communications software packages interpret this to mean the modem is always on-line. To reset the modem so the DCD line isn't always active, enter this command from the communications software command (or terminal) mode: `AT&C1&W` Another cause: some private branch exchanges (PBXs) don't recognize pulse dialing. Check with your PBX administrator.
Local data modem and remote data modem can't make a connection	The telephone lines may be so noisy that a connection isn't possible. Try again. Also try sending to a different modem to test whether your modem works. If the remote modem is non-MNP, try a direct connection with the \N0 command.
A data link is established, but a call hasn't been received	The Carrier Detect override may be on. Type AT&C1 from the communications software command (or terminal) mode to turn off the override.
An application says not enough extended or expanded memory is available	Run SETUP. From SETUP's *Advanced setup/Set up pop-up options,* set *Swap media* to "don't use EMS or XMS".

Table C-1 *Symptoms and possible solutions (continued)*

Symptom	*Possible solution*
Double characters appear on the screen	The modem's echo command is on. Use the command in your communications program to turn off the echo, try making a full-duplex connection, or turn echo off by typing ATE0 from the communications software.
Data modem won't respond "OK" when you type AT commands	Be sure you're typing in either uppercase or lowercase letters, not a combination; be sure you press the Enter↵ key at the end of the command. Check whether the communications software requires you to be in command (or terminal) mode (check the communications software manual). Check whether the fax modem is currently sending or receiving a fax. You can't use the data modem when faxing. If you still have problems, there's probably an IRQ conflict with another board or COM port. If you have a Classic bus computer, run the SETUP program. From the *Advanced setup/Set up hardware* screen, choose a different COM port. If you have a Micro Channel computer, use your reference diskette to select a different COM port. (Remember to change your communications software so it uses the new COM port you selected.)

If you couldn't get your fax modem to work with the help of this troubleshooting section, call PureData Customer Support at the numbers listed in the SatisFAXtion user's guide.

C-4 If something doesn't work

Glossary

This glossary defines some of the technical terms used in this manual. The terms are defined in alphabetical order.

American Bell standard (Bell 103 and 212A)

A North American standard that specifies the way modems transmit information.

- Version 103 of the Bell standard applies to asynchronous modems transmitting at speeds up to 300 bps.

- Version 212A applies to full duplex asynchronous or synchronous modems that transmit at speeds up to 1200 bps.

Answer mode

The mode the modem normally uses when answering a call from another computer. Contrast this mode with originate mode, which the modem uses when calling another computer. Although your modem can operate in either originate or answer mode, some modems operate only in originate mode. To communicate with these modems, your modem can switch to answer mode when placing a call.

ASCII

American Standard Code for Information Interchange. This is a standard method of encoding characters that lets text generated by one program or computer to be understood by another program or computer.

Asynchronous communication

Communication between computers at irregular intervals. To handle this kind of communication, the modem adds start and stop bits to each character it sends. The start bit lets the receiving computer know when a new character has started. The stop bit indicates the end of the character.

AT command set

The set of commands used to control the modem. It's called the AT command set because each command line must start with the two-character attention code **AT** (or **at**). The original AT command set was defined by Hayes Corporation and is now an industry standard for modems.

Attention code

A two-character sequence (**AT** or **at**) that signals the modem that one or more modem commands follow on that line. Every time the modem receives an attention code, it examines the characters to determine the communications rate of the port, the parity setting, and the stop bits. The modem automatically adjusts its settings to match the protocol the computer is using and stores those settings in its RAM. It maintains these settings until it receives another **AT** attention code, or until you turn off the computer.

Automatic answering

When the modem automatically answers the phone after a certain number of rings. You set the modem to answer using the S0 register. (Use SETUP to specify the number of rings the modem answers on.) Automatic answering is in contrast to manual answering, in which a person must invoke the **A** command to cause the modem to answer the phone. See Chapter 5 for more information about automatic and manual answering.

Automatic dialing

When the modem (in response to a **D** command) dials the phone. This is in contrast to manual dialing, where a person dials the number. See Chapter 4 for more information about automatic dialing.

Baud rate

The number of symbols transmitted per second. This is not always the same as the bps rate (see "Bits per second"), because a symbol, or baud, may have more than one bit.

Bits per second

The speed at which a modem sends or receives information. For example, a modem that operates at 2400 bits per second can transfer 2400 binary digits each second. A character normally consists of seven or eight of these binary digits, plus the start and stop bits that separate the character from other transmitted characters.

Buffer

A temporary storage unit that the modem uses as it accepts information at one rate and delivers it at another. For example, a modem sometimes receives data faster than it can process the data. The modem can temporarily store this excess data in a buffer until the modem can process it.

Carrier

The base signal used to transmit data across a phone line. The modem modulates this signal (alters its frequency or phase) to encode the data to be transmitted into the base signal.

Clear to send (CTS)

A signal defined in the RS-232C data communication standard that indicates to the computer that it can begin sending information. (See "Request to send (RTS)" on page Glossary-11)

Command mode

One of two operating modes of the modem (the other is called on-line mode). Command mode is sometimes called local mode or terminal mode. In command mode, the modem interprets any information it receives from the local computer as modem commands. It tries to perform the commands sent to it, and it returns result codes indicating the results of the commands. The modem enters command mode when you turn on or restart (Ctrl-Alt-Del) your computer, and when you type the escape sequence (normally +++) while the modem is in on-line mode.

Communication (COM) ports

The connectors and accompanying circuitry on your computer that let you connect serial devices (usually serial printers, modems, or mice) to your computer and communicate with these devices. DOS assigns names that begin with the letters COM to serial ports (such as COM1 and COM2).

Configuration profile

The operating characteristics of the modem are maintained in the modem's 28 S-registers. Whenever you issue a modem command to change one of the operational characteristics (such as setting the volume control or turning the speaker on or off), the modem changes the values in the S-registers to reflect your changes. The configuration profile of the modem is the current settings of the S-registers.

Consultative Committee for International Telephone and Telegraph (CCITT)

An international committee that specifies the way modems and fax machines transmit information. CCITT specifications ensure compatibility among modems.

- **CCITT V.21** is a specification for 300 bps modems.
- **CCITT V.22** is a specification for 600 and 1200 bps modems.
- **CCITT V.22*bis*** is a specification for 2400 bps modems. (Note: *bis* indicates the second version of the CCITT V.22 standard.)
- **CCITT V.32** is a specification for 4800 bps and 9600 bps modems.
- **CCITT V.32*bis*** is a specification for 4800 bps, 7200 bps, 9600 bps, 12000 bps, and 14400 bps modems. (Note: *bis* indicates the second version of the CCITT V.32 standard.)
- **CCITT V.42** is a specification for error control.
- **CCITT V.42*bis*** is a specification for data compression. (Note: *bis* indicates the second version of the CCITT V.42 standard.)
- **CCITT V.54** is a test specification.

Data carrier detect (DCD)

A signal defined in the RS-232C data communication standard that indicates that the modem is receiving a carrier signal from a remote modem.

Data compression

A technique to reduce the number of bits of information that need to be transmitted.

Data set ready (DSR)

A signal defined in the RS-232C data communication standard that indicates to the computer that the modem is connected to the phone line.

Data terminal ready (DTR)

A signal defined in the RS-232C data communication standard that indicates to the modem that the local computer (or terminal) is ready for data transmission.

Dial modifiers

Modem commands that you enter along with the **D** (dial) command to further instruct the modem when dialing the phone. Dial modifiers specify whether to use pulse or tone dialing, when and how long to pause before continuing, whether to dial a stored number, whether to use reverse (answer) mode, where to include hook flashes, and whether to place the modem in command mode after dialing. Chapter 4 has information about all the dial modifiers.

Duplex

The way that modems send and receive data. There are two methods: half duplex (only one modem can send data at a time) and full duplex (both modems can send data simultaneously).

Error control

A modem that supports error control can detect and sometimes correct errors in the data.

Escape sequence

A sequence of three characters (normally +++) that switches the modem from on-line mode to command mode without breaking the phone connection.

File transfer protocol

An error-checking protocol for file transfers. It monitors information sent with each block of data. If the received data doesn't match the information used to check the quality of data, the system notifies the sender that an error has occurred and asks for a retransmission. This continues either until all the data has been received or until the transmission has been canceled.

Flow control

A method used to regulate the flow of data between two devices, such as modems.

Guard time

A period of time during which the modem must not receive characters. The escape sequence (normally +++) has a guard time to ensure that data sent from a remote modem isn't interpreted as an escape sequence. The factory setting for the guard time is one second. Therefore, to be interpreted as a legitimate escape code, there must be one second before and one second after the escape sequence in which the modem doesn't receive any characters.

Hook flash

A hook flash is done by hanging up the phone for a short period of time (one-half second). This operation is useful in some PBX systems, which treat a hook flash as a signal to perform other services, such as transferring a call.

LAPM

Link Access Procedure for Modems. LAPM is an error control protocol specified in the CCITT V.42 specification for error control. LAPM provides error control when your modem is communicating with another modem that supports LAPM.

Line noise

Random signal disturbances that sometimes occur over phone lines. Noise can disrupt communications and threaten the integrity of the data transmitted.

Loopback test

A diagnostic test where characters that are sent to the modem are immediately sent back from the modem so the computer can compare the characters sent with the characters received.

Manual dialing

When a person dials a phone number using a phone connected to the modem. This is in contrast to automatic dialing, where the modem dials the number. See Chapter 4 for more information about using your modem when dialing manually.

MNP

Microcom Networking Protocol. MNP has 5 classes of operation. MNP classes 1 through 4 are intended to provide error-free (or reliable) transmission of data (as specified in the CCITT V.42 specification for error control as a backup error control scheme for LAPM). Each successive MNP class provides the advantages of the previous MNP classes, plus its own advantages.

Class 1

Class 1 sends data in one direction at a time. The sending modem sends a block of data and waits until the receiving modem acknowledges it received the data before sending another block.

Class 1 is about 70 percent efficient. That is, a 2400-bit-per-second (bps) modem will send data at 1690 bps. Class 1 (also called block mode) isn't used much.

Class 2

Class 2 sends data in both directions at the same time. Class 2 is about 84 percent efficient. That is, a 2400-bps modem will send data at 2000 bps. Class 2 (also called stream mode) isn't used much.

Class 3

Class 3 (like Class 2) sends data in both directions at the same time. Class 3 is more efficient than Class 2 because the sending modem strips the start and stop bits from the data block before it's sent. The receiving modem adds the start and stop bits before it passes the data to the receiving computer.

Class 3 is about 108 percent efficient. That is, a 2400-bps modem will send data at 2600 bps.

Class 4

Class 4 adds two features to Class 3. If the phone line is relatively free of noise, the modem sends a larger than usual block of data to increase throughput. If the phone line is noisy, the modem sends smaller packets of data. While smaller packets take longer to send, they are faster on noisy lines because the modem doesn't have to retry as much. This means more successful transmissions on the first try.

Most of the administrative information in the header of data blocks stays the same from block to block. When operating in Class 4, the modem streamlines the information in the headers of data blocks.

Class 4 is about 120 percent efficient. That is, a 2400-bps modem will send data at 2900 bps.

Class 5

Class 5 adds data compression to Class 4 capabilities. The sending modem detects redundant data and recodes it to fewer bits so the effective throughput is greater. The receiving modem decompresses the data before passing it along to the receiving computer.

Class 5 is about 200 percent efficient. That is, a 2400-bps modem will send data at 4800 bps. (Throughput will vary, depending on how compressible the data is. Data that is already compressed can actually take longer if the modem is operating in Class 5.)

Different modems support different classes. Before they transmit data, sending and receiving modems agree on a connection at the highest MNP class they both support.

Modem

The term modem is derived from modulator/demodulator. It is a device that transforms (modulates) a computer's digital signals into analog signals that can be sent across a phone line. It also demodulates analog signals it receives from the phone line, converting them back to digital signals the computer can understand.

Nonvolatile memory

Memory that retains the information stored in it even if you turn off the computer. There are two kinds of nonvolatile memory: ROM and NVRAM. ROM is programmed with information at the factory and can't be changed by users. NVRAM is used to store configuration information and can be changed with modem commands. Throughout this manual, the term nonvolatile memory refers solely to the NVRAM used to store configuration information.

Off-hook

The condition of a phone line that corresponds to picking up the phone receiver. A modem creates an off-hook condition when it tries to communicate on a phone line.

On-hook

The condition of a phone line that corresponds to hanging up the phone receiver. A modem creates an on-hook condition to break its connection to a phone line.

On-line mode

One of two operating modes of the modem (the other command mode). On-line mode is also called data mode. In on-line mode, the modem interprets all information sent to it as data, not commands. The only exception is the escape sequence, a special sequence of characters that returns the modem to command mode without breaking the connection. The modem is placed in on-line mode when it establishes a connection with a remote modem, or when you enter the **O** command to return to a previously established connection.

Originate mode

Mode the modem normally uses when calling another computer. Contrast this mode with answer mode, which the modem uses when answering a call from another computer. Although your modem can operate in either originate or answer mode, some modems operate only in originate mode. To communicate with these modems, your modem can switch to answer mode when placing a call.

Parity

A scheme that computers use to check the validity of transmitted characters. This scheme adds an extra bit to each character, which the transmitting computer sets or clears based on the type of parity the computers agree to use. For example, if the computers use even parity, the transmitting computer sets or clears the parity bit so there are an even number of bits set in each character it transmits. The receiving computer checks each character and flags a parity error if any character has an odd number of bits set. Odd parity is similar, except the transmitting computer ensures that each character has an odd number of bits set.

Protocol

A set of rules that governs how data is transmitted. To communicate successfully, two computers must use the same protocol.

Pulse dialing

One of two methods of dialing the phone (the other is tone dialing). With pulse dialing, the modem sends pulses to represent the phone numbers (one pulse for a one, two pulses for a two, etc.). Pulse dialing is normally associated with rotary-dial phones.

Request to send (RTS)

A signal defined in the RS-232C data communication standard that requests the modem to send data.

Result codes

For most modem commands, when you enter command, the modem displays a message on your screen indicating the results of the command. These messages are called result codes. In the factory setting, result codes are returned as English words that describe the conditions. You can also set the modem to display corresponding numeric values instead of words.

RS-232C

The recommended standard of the Electronic Industries Association (EIA) for exchanging information between Data Terminal Equipment (such as computers) and Data Communications Equipment (such as modems). Your modem and your computer's serial ports adhere to the RS-232C standard.

S-registers

Locations in the modem's memory used to store the current configuration settings of the modem. There are 28 S-registers, labeled S0 through S27. The S-registers, and the commands to set them and read them, are described in Chapter 8.

Serial port

A connector to which you can attach a serial device such as a printer, a mouse, or a modem.

Start/stop bits

Signals that define the beginning and end of a data block.

Tone dialing

One of two methods of dialing the phone (the other is pulse dialing). With tone dialing, the modem sends tones of different frequencies to represent the phone numbers. Tone dialing is normally associated with push-button (touch-tone) phones and is also called Dual Tone Multi-Frequency (DTMF) dialing.

Throughput

The total useful information processed or communicated in a specified amount of time.

V.32

The CCITT V.32 specification for 9600 bps and 4800 bps communications.

V.32*bis*

The CCITT V.32*bis* specification for 14400 bps, 12000 bps, 9600 bps, 7200 bps, and 4800 bps communications. (Note: *bis* indicates the second version of the CCITT V.32 standard.)

V.42

The CCITT specification for error control. The V.42 specification lists LAPM as the primary error control protocol and MNP classes 1 through 4 as a backup protocol for error control.

V.42*bis* data compression

A data compression scheme that conforms to the V.42*bis* specification for data compression can cause data to be transmitted up to 400 percent faster than it would have been transmitted without data compression. V.42*bis* data compression can be used only with LAPM error control. It doesn't slow down when transferring certain types of data, such as compressed files. MNP 5 doesn't conform to the V.42*bis* specification. (Note: *bis* indicates the second version of the CCITT V.42 standard.)

XON/XOFF

A method of controlling the flow of data between a modem and its host computer and between two modems. XON stands for "Transmitter On," and XOFF stands for "Transmitter Off." If the modem receiving data needs time to process the data or do some other task, it sends an XOFF signal to the host computer (or sending modem). On receiving this signal, the host computer (or sending modem) waits until it receives an XON signal from the other modem before sending more data. XON/XOFF flow control is also called software flow control.

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IF YOU NEED TO CONTACT PUREDATA CUSTOMER SUPPORT

Notice:

All SatisFAXtion Support Services will be phased from Intel to PureData by the second quarter of 1995. During this time you may continue to receive support from Intel's traditional support services, or PureData's equivalent services as they come on line.

As PureData builds up the necessary support services, the numbers in the INTEL column below will disappear while equivalent numbers for PureData will appear in the right hand column. Services that have numbers listed in both columns indicates that the equivalent service is currently maintained at both facilities.

These numbers will be effective as of December 15th, 1994. There may be updates to this information since the time of printing. Please refer to the back of the letter included in the box with your SatisFAXtion product for updated information.

When you contact us with a question: Have ready your phone number and fax numbers, your product's serial number or product code, a description of your computer hardware (including all add-in boards, their I/O ports, and IRQs) and software, copies of your CONFIG.SYS and AUTOEXEC.BAT files, and a problem description including error messages.

We will answer your questions using the same type of service you used to contact us. We'll do our best to respond by the end of the next business day.

Type of Service	How to Contact Us	How to Contact Intel
Call the PureFACTS document delivery service	U.S. and Canada (800) 661-8210 Europe: N/A	U.S. and Canada (800) 525-3019 Europe: +44-793-432509 International: +503-629-7576 24 hours a day
Call the PureData electronic Bulletin Board Service (BBS)	U.S.A: N/A Canada: N/A Europe: N/A	Worldwide: +503-645-6275 Europe: +44-793-432955 24 hours a day
Use CompuServe	Go PUREDATA	Go INTELFORUM
Use Internet	support@puredata.com	
Fax Us Your Questions	U.S. (214) 242-9487 Canada: (905) 731-7017 Europe: +31-79-428212 24 hours a day	U.S. and Canada: (800) 525-3019 Europe: +44-793-431166 International +503-629-7580 24 hours a day
Write a letter	PureData Customer Support 180 West Beaver Creek Road Richmond Hill, Ontario Canada, L4B 1B4	
Talk to a technician	Worldwide: +503-968-1797 Mon-Fri, 7-5 US Pacific time Closed Thursday 3-5pm	Europe: in English: +44-793-431144 en Francais:+44-793-421777 auf Deutsch:+44-793-421333 Mon-Fri, 08:00-17:30

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